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Correlation of Handgrip Strength and Selected Anthropometric Variables in Indian Inter-University Cricketers

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Abstract: ***Introduction: Cricket is a popular team game in most Commonwealth countries. The objectives of the present study were to estimate the handgrip strength of inter-university cricketers, and to search its correlations with selected anthropometric variables studied. Materials and Methods: A total of 100 inter-university cricket players (50 males and 50 females) aged 18-25 years were selected purposively from different universities of Punjab, India. An adequate number of controls (n=100; 50 males and 50 females) were taken from the same place for comparisons. To serve these purposes, dominant and non-dominant handgrip strength and eight anthropometric variables, viz. height, weight, body mass index, arm muscle girth, arm muscle area, arm area, arm fat area and arm fat index were measured on all the subjects. The age of the subjects was determined from their respective university records. Results: The one way analysis of variance of handgrip strength indicated statistically significant between-group differences (p≤0.003-0.001) with all the variables studied, except, arm fat index. In cricket players, statistically significant positive correlations (p≤0.03-0.001) of dominant handgrip strength were found with weight, arm muscle girth, arm muscle area, arm area, arm fat area, arm fat index and non-dominant handgrip strength. Whereas, statistically significant positive correlations (p≤0.004-0.001) of non-dominant handgrip strength in cricket players were found with weight and dominant handgrip strength only. Conclusion: It may be concluded from the findings of the present study that cricketers have higher mean values in almost all the variables due to playing habit and training effects. In cricket players, dominant handgrip strength had significantly positive correlations with weight, arm muscle girth, arm muscle area, arm area, arm fat area, arm fat index and non-dominant handgrip strength.***

Keywords: Anthropometric variables. Handgrip strength. Inter-university cricketers

1. Introduction

1) Cricket is a game of endurance as well as strength. It is a popular team game in most Commonwealth countries. In past, it was played solely in a specific season (in Asian countries it was in winter and in western countries it was in summer). But its popularity has gained tremendous momentum since last few decades and now it is played throughout the year. The cricketers are exposed to more demanding schedules, with longer period of time for training and practicing (Davies et al., 2008). The increased workload may be one of the contributing factors to the increased incidence of injuries. Thus, research in this field is required to avoid the sports-specific injuries, to excel the performance of the cricketers, to strengthen the training program and to search the talents in the game.

2) Handgrip 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 handgrip is the result of forceful flexion of all finger joints, thumbs, and wrists with the maximum voluntary force that the subject is able to exert under normal biokinectic conditions. Handgrip strength is a physiological variable that is affected by a number of factors including age, gender and body size etc. (Sanchez-munoz et al., 2007). The estimation of handgrip strength is of immense importance in determining the efficacy of different treatment strategies of hand and also in hand rehabilitation (Güçlüöver et al., 2012). In different sports events, estimation of handgrip strength helps to screen the talents as well as performance development (Jurimae et al., 2009). Handgrip strength is a significant predictor of performance in various sports activities, viz. lawn tennis (Lucki and Nicolay, 2007), club volleyball (Melrose et al., 2007), ten-pin bowling (Tan et al., 2001), rock climbing (Watts et al., 2003). Strong correlations between grip strength and various anthropometric traits, (weight, height, hand length etc.) were reported earlier by Malina et al. (1987) and Ross and Rosblad (2002).

3) Anthropometric dimensions and morphological characteristics play an important role in determining the success of an athlete (Reco-Sanz, 1998; Wilmore, 1999; Keogh, 1999). It has been well established that specific physical characteristics or anthropometric profiles indicate whether the player would be suitable for the competition at the highest level in a specific sport (Claessens et al., 1999; Bourgois et al. 2000; Gabbett, 2000, Ackland et al., 2003; Slater et al., 2005).

4) The literature related to correlations of handgrip strength and anthropometric variables in cricketers are scanty (Stuelcken et al. 2007; Stretch 1987, 1991; Elliott, 2000; Elliott and Foster, 1984; Elliot et al., 1986; Foster and Elliot, 1985; Foster et al., 1989), especially in Indian context. To fulfill the lacunae of knowledge, in the present study, an attempt has been made to estimate the handgrip strength of inter-university cricketers, and to search its correlations with selected anthropometric variables.

2. Materials and Methods

1) Participants

A total of 100 inter-university cricket players (50 males and 50 females) aged 18-25 years were selected purposively from different universities of Punjab, India. An adequate number of controls (50 males and 50 females) were taken for comparison from the same place matching age, sex socio economic status and ethnicity. The age of the subjects was determined from their respective university records. A written consent was obtained from the subjects. The data was collected under natural environment conditions. The study was approved by the Institutional ethics committee.

2) Measurement of Handgrip Strength

The handgrip strength measurement was done using a standard adjustable digital handgrip dynamometer (Takei Scientific Instruments Co., LTD, Japan) at standing position with shoulder adducted and neutrally rotated and elbow in full extension. The dynamometer was held freely without support, not touching the subject's trunk. The subjects were asked to exert maximum force on the dynamometer thrice by their hands and the maximum value in kilograms was recorded. Anthropometric equipment and handgrip dynamometer were calibrated before each assessment. Thirty seconds time interval was maintained between each handgrip strength testing.

3) Anthropometric Measurements

Anthropometric variables of the subjects were measured using the techniques provided by Lohmann et al. (1988) and were measured in triplicate with the median value used as the criterion. Subjects were weighed in minimal light-weight clothing, bare foot, using standard weighing machine. Stadiometer (Holtain Ltd. Crymych, Dyfed, UK) was used for measuring standing height. Subjects were asked to stand bare foot on horizontal surface. Heel touched the ground, counter board of stadiometer was brought down till it touches the vertex. The height of subjects was recorded in cm. The weight was measured by digital standing scales (Model DS-410, Seiko, Tokyo, Japan) to the nearest 0.1 kg. Body mass index (BMI) was calculated from height and weight as follows: BMI=weight (kg) / height^2(m^2). Arm muscle girth, arm muscle area, arm area, arm fat area and arm fat index were derived from the following formula after McArdle et al. (2001):

1) Arm muscle girth (cm)=[uac-(π $triceps$ $skinfold$)]
2) Arm muscle area (cm^2)=[uac-(π $triceps$ $skinfold$)]/4π
3) Arm area (cm^2)=(uac)²/ 4π
4) Arm fat area (cm^2)=arm area-arm muscle area
5) Arm fat index=arm fat area/arm area

4) Statistical Analysis

Descriptive statistics (mean ± standard deviation) were determined for the directly measured variables as well as the derived ones. One way analysis of variance was tested for the comparisons of data among Indian inter-university cricketers and controls, followed by post-hoc Bonferroni test. Pearson's correlation coefficients were applied to establish the relationships among the variables measured. Data were analyzed using SPSS (Statistical Package for Social Science) version 20.0. A 5% level of probability was used to indicate statistical significance.

3. Results

1) Table 1 showed one way analysis of variance of handgrip strength and selected anthropometric variables in cricket players and controls. Statistically significant between-group differences ($p \leq 0.003$-0.001) were found in all the variables, except, arm fat index among these four sets of data.

2) The Pearson's correlation coefficients (r) of dominant handgrip strength with selected anthropometric variables in inter-university cricket players were shown in table 2. Statistically significant positive correlations ($p \leq 0.03$-0.001) of dominant handgrip strength in cricket players were found with weight, arm muscle girth, arm muscle area, arm area, arm fat area, arm fat index and non-dominant handgrip strength. Whereas, statistically significant positive correlations ($p \leq 0.004$-0.001) of non-dominant handgrip strength in cricket players were found with weight and dominant handgrip strength only.

Table 1: One way analysis of variance (ANOVA) of handgrip strength and selected anthropometric variables in cricketers and controls

Variables	CM		CF		ConM		ConF		F- value	P value
	Mean	SD	Mean	SD	Mean	SD	Mean	SD		
HT (cm)	170.0	5.54	156.52	8.49	167.96	5.64	157.82	6.33	54.66	0.001
WT (kg)	59.28	8.90	51.78	8.50	64.07	13.2	52.00	6.86	19.29	0.001
BMI (kg/m²)	20.48	2.83	21.10	2.88	22.65	4.14	20.87	2.28	4.71	0.003
AMG (cm)	22.23	2.14	20.24	1.91	22.85	2.43	20.86	1.83	16.68	0.001
AMA (cm²)	22.64	2.20	20.84	2.01	23.32	2.53	21.42	1.85	13.66	0.001
AA (cm²)	462.12	93.27	423.17	93.09	498.81	119.52	435.40	78.31	5.99	0.001
AFA (cm²)	439.48	91.11	402.33	91.18	475.48	117.03	413.98	76.57	5.86	0.001
AFI	0.95	0.005	0.94	0.006	0.95	0.006	0.95	0.004	1.77	0.155
DHGS (kg)	32.56	5.46	25.20	4.62	35.64	5.36	23.84	4.17	67.19	0.001
NDHGS (kg)	29.60	5.67	22.96	4.52	32.47	5.67	20.76	3.47	62.79	0.001

CM = cricketer males, CF = cricketer females, ConM= control males. ConF = control females, HT = height, WT = weight, BMI = body mass index, AMG = arm muscle girth, AMA = arm muscle area, AA = arm area, AFA = arm fat area, AFI = arm fat index, DHGS = dominant handgrip strength and NDHGS = non-dominant handgrip strength.

Table 2: Correlation matrix of handgrip strength and selected anthropometric variables in inter-university cricketers

Variables	HT	WT	BMI	AMG	AMA	AA	AFA	AFI	DHGS	NDHGS
HT	1	0.42*	-0.12	0.35*	0.35*	0.32*	0.32*	0.32*	0.16	0.26
WT	0.55**	1	0.90**	0.76**	0.77**	0.81**	0.81**	0.81**	0.31*	0.30*
BMI	-0.11	0.76**	1	0.67**	0.69**	0.74**	0.74**	0.73**	0.25	0.20
AMG	0.46**	0.74**	0.52**	1	1.00**	0.96**	0.96**	0.91**	0.29*	0.20
AMA	0.44**	0.79**	0.59**	1.00**	1	0.98**	0.98**	0.93**	0.29*	0.20
AA	0.37*	0.87**	0.75**	0.91**	0.95**	1	1.00**	0.97**	0.28*	0.19
AFA	0.37*	0.87**	0.75**	0.90**	0.95**	1.00**	1	0.97**	0.28*	0.19
AFI	0.28*	0.86**	0.81**	0.78**	0.84**	0.96**	0.96**	1	0.27*	0.19
DHGS	0.41*	0.33*	0.05	0.43*	0.40*	0.29*	0.29*	0.20	1	0.80**
NDHGS	0.44**	0.26	-0.04	0.38*	0.36*	0.25	0.25	0.18	0.83**	1

The upper triangle represented the male cricketers and the lower triangle the female cricketers.
* indicated p<0.01, ** indicated p<0.001

4. Discussion

1) Handgrip strength is important for catching and throwing the ball in different team sports (Fallahi and Jadidian, 2011). Hand dimensions are the most important hand anthropometric variables in relation to handgrip strength (Visnapuu and Jurimae, 2007). Strengthening of the grip has been a prescription for rehabilitation from injuries such as golfers and tennis elbow (Budoff, 2004).

2) The findings of the study indicated that male cricketers had significantly greater mean values ($p \leq 0.04$-0.001) in body height, weight, dominant and non-dominant handgrip strength, arm muscle girth, arm muscle area, arm area, arm fat area than their female counterparts. It may be due to genetic predisposition and growth affected by sports activity. The greater values of handgrip strength in male cricketers might be due to greater muscle mass than the female cricketers. Benefice et al. (1996) stated that males attained a stronger handgrip than their female counterparts. Right and left handgrip strength was positively correlated with weight, height and body surface area (Chatterjee and Chowdhuri, 1991). Males cricketers were found to have higher mean values in height and have lower mean values in body weight, body mass index, dominant handgrip strength, non-dominant handgrip strength, arm muscle girth, arm muscle area, arm area, arm fat area and arm fat index than control males. This is, might be, due to training effects. Statistically significant differences ($p \leq 0.03$-0.001) were noted in body weight, body mass index, dominant and non-dominant handgrip strength among them. The greater values of handgrip strength in control males may be due to small sample size in cricketers. Pieterse et al. (2002) reported that low BMI and low arm muscle area emerged as a significant determinant of impaired handgrip strength.

3) Females cricketers were found to have higher mean values in body mass index, dominant and non-dominant handgrip strength, than control females and were found to have lower mean values in body weight, height, arm muscle girth, arm muscle area, arm area, arm fat area and arm fat index than control females due to their regular training effects. Statistically significant differences were noted in dominant and non-dominant handgrip strength among them. Control males were found to have significantly higher mean values in body weight, height, body mass index, dominant and non-dominant handgrip strength, arm muscle girth, arm muscle area, arm area, arm fat area than control females. These differences are due to general physical and physiological sex-differences.

4) Grants et al. (2001) recorded significantly higher values for right handgrip strength in elite rock climbers than recreational climbers. De et al. (1982) reported that the handgrip 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.

5) Results of the present study showed statistically significant positive correlations ($p \leq 0.03$-0.001) of dominant handgrip strength with arm muscle girth, arm muscle area, arm area, arm fat area and arm fat index in cricket players. It also showed significant positive correlations ($p \leq 0.004$-0.001) of non-dominant handgrip strength with arm muscle girth, arm muscle area, arm area, arm fat area in cricket players.

6) Tsuji et al. (1995) showed that grip strength was one of the determinant factors of radial bone mineral density in the dominant forearm of young college athletes. Whereas, Ducher et al. (2005) 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 et al. (2001) observed that handgrip 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 et al., 2003).

7) Justifications were also made to incorporate the inter-university cricketers in the present study. In fact, university level cricketers usually represent the provincial level competitions and subsequently the national levels. Their standard is superior to the beginners but slightly inferior to the elites. Thus, this stage is the ideal buffer for screening the talents for international competitions. Koley and Yadav (2009), Koley et al. (2009) and Kumar et al. (2007) reported the association of handgrip strength with certain anthropometric characteristics in Indian university level cricketers. 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.

5. Conclusion

It could be concluded that the handgrip strength was positively correlated with number of anthropometric variables like weight, arm muscle area, arm area and arm fat area both in male and female cricketers. Thus, the finding may be helpful for the development of training program separately for male and female cricketers, identification of talents in the game and to keep the sport-specific injuries at bay.

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