

# Correlations of Handgrip Strength with Selected Anthropometric Variables in Indian Inter-University Kabaddi Players

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**Abstract:** *Introduction:* Kabaddi is an ancient team-game of India. The objectives of the present study were to estimate the handgrip strength of inter-university kabaddi players, and to search its correlations with selected anthropometric variables. *Materials and Methods:* A total of 100 inter-university Kabaddi 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, upper arm circumference, triceps skinfold, arm muscle area, arm fat area and % body fat 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 ( $p \leq 0.001$ ) with all the variables studied. In male kabaddi players, statistically no significant correlations of dominant handgrip strength were found with any of the variables studied. Whereas, in female Kabaddi players, statistically significant positive correlations ( $p \leq 0.05-0.001$ ) of dominant handgrip strength were found with weight, upper arm circumference and triceps skinfold. *Conclusion:* It might be concluded from the findings of the present study that Kabaddi players had higher mean values in almost all the variables due to playing habit and training effects. In female kabaddi players, dominant handgrip strength had significantly positive correlations with weight, upper arm circumference, triceps skinfold.

**Keywords:** Handgrip strength. Anthropometric variables. Indian inter-university kabaddi players

## 1. Introduction

1) Kabaddi is the contact team sport that originated in South India. Kabaddi is the National game of Iran and Bangladesh and the State game of Punjab, Tamil Nadu, and Andhra Pradesh (Jeyaraj and Gopinathan, 2014). It requires a small field area of 12.5×10 m which is divided into two equal halves one for the raiders and another for the defenders and interestingly this sport requires no equipment to play (Sudhakar et al., 2014).

2) The anthropometric profile of a sport provides a set of performance characteristics of the athlete that can be used to identify talent and develop sport-specific training programs (Gualdi-Russo and Zaccani, 2001). At present, sportsmen for superior performances in any sports are selected on the basis of physical structure and body size. Structural measurement include anthropometric measurements which consist of objective measurement of structures such as height, weight, width, depth and the circumference of the various part of body (Ravindra-Gouda and Virupaksha, 2014).

3) The power of handgrip is the result of forceful flexion of all finger joints with the maximum voluntary force that the subject is able to exert under normal biokinetic conditions (Richards et al., 1996; Bohannon, 1997), which uses several muscles in the hand and the forearm (Bassey and Harrie, 1993). Grip strength is often used as an indicator of overall physical strength (Massey-Westrop et al., 2004; Foo, 2007), hand and forearm muscles performances (Nwuga, 1975) and as a functional index of nutritional status (Chilima and Ismail,

2001; Pieterse et al., 2002), physical performance (Samson et al., 2000; Onder et al., 2002).

4) 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 (Malina et al., 1987; Ross and Rösblad, 2002; Singh et al., 2009; Koley and Yadav, 2009; Koley and Singh, 2009; Koley et al., 2009; Jurimae et al., 2009; Kaur, 2009).

5) Several studies have examined the relationships of between anthropometric and physiological characteristics of kabaddi players (Dey et al., 1993; Majlesi et al., 2012; Patel and Dutta, 2014; Mangesh, 2012). But information related to the estimation of handgrip strength and its correlations with anthropometric variables in kabaddi players are limited. So the present study was planned.

## 2. Materials and Methods

### 1) Participants

The present cross-sectional study was based on 100 inter-university kabaddi players (50 males and 50 females) aged 18-25 years selected purposively from different universities of Punjab, India. An adequate number of controls (n=100, 50 males and 50 females) were also taken from the same place matching age, sex, socio-economic status, except the playing habit. Demographic information in the form of questionnaire was taken from each subject. The age of the subjects was

determined from their respective university records. A written consent was obtained from the subjects. The data were collected under natural environmental conditions in morning (between 8 AM to 12 noon). The study was approved by the institutional ethical committee.

## 2) Handgrip Strength Measurement

The grip strength of both right dominant and left non-dominant hands was measured 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 position of the hand remained constant without the downward direction. The subjects were asked to put maximum force on the dynamometer thrice from both sides of the hands. The maximum value was recorded in kilograms. Anthropometric equipment and handgrip dynamometer were calibrated before each assessment. All subjects were tested after 3 minutes of independent warm-up.

## 3) Anthropometric Measurements

Eight anthropometric variables, viz. height (HT), weight (WT), body mass index (BMI), upper arm circumference (UAC), triceps skinfold (TSF), arm fat area (AFA), arm muscle area (AMA) and % body fat (%BF) were taken on each subject. 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. 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. BMI was then calculated using the formula  $\text{weight (kg)}/\text{height}^2 (\text{m}^2)$ . Upper arm circumference was measured by steel tape in centimeter. triceps skinfold was measured by Harpenden skin fold caliper in mm. 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):

- a) Arm muscle girth (cm)=[uac-( $\pi$  triceps skinfold)]
- b) Arm muscle area ( $\text{cm}^2$ )=[uac-( $\pi$  triceps skinfold)]/4 $\pi$
- c) Arm area ( $\text{cm}^2$ )=(uac)<sup>2</sup>/ 4 $\pi$
- d) Arm fat area ( $\text{cm}^2$ )=arm area-arm muscle area
- e) Arm fat index=arm fat area/arm area

Percent body fat was calculated with the following formula (Durnin and Womersley., 1974):

Per-cent body fat = Females (17-68 years) = (1.37 × BMI – 3.47)

Males (17-76 years) = (1.34 × BMI – 12.47)

## 4) Statistical analysis

Standard descriptive statistics (mean ± standard deviation) were determined for directly measured variable. One way analysis of variance was tested for the comparisons of data among Indian inter-university kabaddi players 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 17.0. A 5% level of probability was used to indicate statistical significance.

## 3. Results

1) One way ANOVA of handgrip strength and selected anthropometric variables in Indian inter-university kabaddi players and controls were shown in Table 1. Results showed significant between-group differences ( $p < 0.001$ ) in all the variables studied among the male and female kabaddi players and controls. When male and female kabaddi players were compared with their control counterparts, statistically significant differences ( $p < 0.001$ ) of dominant and non-dominant handgrip strength were found. However, significant sex differences ( $p \leq .001$ ) of dominant and non-dominant handgrip strength were also noted in inter-university kabaddi players.

**Table 1:** One way ANOVA of handgrip strength and anthropometric variables in Kabaddi players and controls

variables	Kabaddi males		Kabaddi females		Control males		Control females		F-value	P-value
	Mean	SD	Mean	SD	Mean	SD	Mean	SD		
Height (cm)	168.88	6.32	161.55	4.06	168.12	6.64	162.44	1.14	24.317	<b>0.001</b>
Weight (kg)	71.98	4.25	55.59	5.44	69.70	5.81	62.04	8.44	73.250	<b>0.001</b>
Body mass index	25.90	4.69	21.29	1.95	24.70	2.12	23.49	2.96	31.63	<b>0.001</b>
Dominant handgrip strength ( $\text{kg}^2$ )	33.08	2.10	19.08	1.77	27.72	1.89	17.44	1.61	788.38	<b>0.001</b>
Non-dominant handgrip strength (kg)	31.12	2.10	17.04	1.72	25.80	1.90	15.48	1.60	803.39	<b>0.001</b>
Upper arm circumference (cm)	25.59	1.82	21.31	2.07	23.79	1.22	21.87	0.75	78.30	<b>0.001</b>
Triceps skin fold(mm)	14.97	0.51	16.42	1.19	14.58	0.81	17.03	0.61	99.57	<b>0.001</b>
Arm muscle area (cm)	11.30	2.20	19.16	2.60	12.15	2.29	20.12	1.42	222.87	<b>0.001</b>
Arm fat area (cm)	63.72	5.95	55.67	6.82	57.33	4.12	58.25	2.82	22.71	<b>0.001</b>
% body fat	22.15	6.29	15.98	2.62	20.54	2.85	18.92	3.96	31.63	<b>0.001</b>

Table 2 showed the bivariate correlations of handgrip strength with selected anthropometric variables in Indian inter-university kabaddi players. In male kabaddi players, dominant and non-dominant handgrip strength had no significant correlations ( $p > 0.05$ ) with any of the variables studied, whereas in female kabaddi players, both dominant handgrip strength had significantly positive correlations ( $p \leq 0.01$ -0.001) with weight, upper arm circumference and

triceps skinfold, and non-dominant handgrip strength had significantly positive correlations ( $p \leq .001$ ) with height, weight, upper arm circumference, triceps skinfold and arm fat area. It was obvious that both in male and female kabaddi players, dominant handgrip strength had significantly positive correlations ( $p \leq 0.001$ ) with non-dominant handgrip strength.

**Table 2:** Correlation matrix of handgrip strength and anthropometric variables in male and female Kabaddi players

	HT	WT	BMI	UAC	TSK	AMA	AFA	%BF	DHGS	NDHGS
HT	1	0.60**	0.63**	-0.23	0.07	-0.23	-0.21	0.63**	0.12	0.12
WT	0.37*	1	0.23	-0.16	0.03	-0.16	-0.17	0.23	0.24	0.26
BMI	-0.13	0.86**	1	0.11	-0.06	0.12	0.08	1.00**	0.07	0.09
UAC	-0.04	0.16	-0.04	1	0.02	0.81**	0.97**	0.11	-0.07	-0.07
TSK	0.22	0.48**	0.39**	0.50**	1	0.56**	0.22	-0.06	-0.03	-0.01
AMA	0.07	0.41**	0.48**	0.23	0.72**	1	0.68**	0.12	-0.04	-0.04
AFA	0.41**	0.33	0.14	0.92**	0.78**	-0.14	1	0.08	-0.08	-0.07
%BF	-0.13	0.86**	1.00**	-0.04	0.39**	0.48**	0.14	1	0.07	0.09
DHGS	0.34	0.40**	0.25	0.36*	0.36*	-0.11	0.41	0.25	1	0.99**
NDHGS	0.37*	0.44**	0.27	0.38*	0.35*	-0.09	0.43*	0.27	0.98**	1

Upper triangle correlations for male kabaddi players and lower triangle correlations for female kabaddi players; \* Significant at .05 level (2-tailed); \*\* Significant for .001 level (2-tailed); HT= height, WT= weight, BMI= body mass index, UAC = upper arm circumference, DHGS = dominant handgrip strength, NDHGS = non-dominant handgrip strength, TSF = triceps skinfold, AFA = arm fat area, AMA = arm muscle area and %BF = % body fat.

## 4. Discussion

1) Kabaddi players require high amount of physical fitness to execute offensive push, falls, turns, sudden change of direction holding, bending, jumping, leg and hand touch, and maintaining hold and respiration. Kabaddi requires both skill and power. It combines the characteristics of wrestling and rugby. Kabaddi players require tremendous physical stamina, agility, individual proficiency, neuromuscular coordination, quick reflexes, intelligence, mental toughness and presence of mind on the part of both attackers and defenders (Jeyaraj and Gopinathan, 2014; Dey et al., 1993).

2) Fine flexibility and agility is developed as one needs to move faster in such a small area of 20'-30'(10-12mts). Player's eyes and body movements become quicker. On the other hand, it requires physical skills, speed, power, strength, endurance, flexibility, swift action, and proper coordination between hand-eyes-limbs for maximal performance. More than speed, acceleration is paramount for the game; strong leg muscles give more punch to the player. Agility and stamina are also very essential (Jadhav, 2011). Kabaddi is rightly called the game of masses as the spectators totally get involved themselves and give the players a great deal of encouragement (Devaraju and Kalidasan, 2012). A range of relevant anthropometric factors can be considered which are subject to strong genetic influences (e.g. stature, grip strength, skinfolds etc.) or are largely environmentally determined and susceptible to training effects.

3) The results of the present study demonstrated significant between-group differences ( $p < 0.001$ ) in dominant and non-dominant handgrip strength and all anthropometric variables studied in male and female kabaddi players and controls. These differences were due to regular physical exercise and training programs in kabaddi players. Significant sex differences were also noted for this trait in kabaddi players. These differences were probably due to structural and physiological variations between the two sexes. The greater values of handgrip strength in kabaddi males might be due to greater muscle mass than the female kabaddi players.

4) In the present study, no significant correlations of dominant and non-dominant handgrip strength were found with any of the anthropometric variables studied in male kabaddi players, whereas in female kabaddi players, both dominant and non-dominant handgrip strength had significantly positive correlations ( $p \leq 0.01-0.001$ ) with weight, upper arm circumference and triceps skinfold. In fact, right dominant handgrip strength was reported to be correlated with weight by Aghazadeh (1993). Tsuji et al. (1995) were in the opinion that grip strength was one of the determinant factors of radial bone mineral density in the dominant forearm of young college athletes. 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. (2003) observed that handgrip strength correlated with throwing speed in experienced pitchers. Though, earlier, in 2001, they showed no significant relationship among the strength variables and ball speed during the tennis serve. More studies are required to validate the data.

## 5. Conclusion

It might be concluded from the present study that kabaddi players of both the sexes had higher mean values in almost all the variables due to playing habit and training effects. In female kabaddi players, dominant handgrip strength had significantly positive correlations with weight, upper arm circumference and triceps skinfold. The findings of the present study have immense practical application in identification of talent with reference to their particular anthropometric parameters in inter-university kabaddi players. It would be helpful in terms of optimizing training programs specific to the requirement of game of kabaddi and would be helpful to keep the injury of the players at bay.

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