

Correlations of Handgrip Strength with Selected Anthropometric Variables in Indian Junior Kabaddi players

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ABSTRACT: *The objectives of the present study were to estimate the handgrip strength of 129 purposively selected Indian junior kabaddi players (67 males and 62 females) aged 12-18 years and to search its correlations with selected anthropometric variables studied. An adequate number of controls were also taken for comparisons. To serve these purposes, dominant and non-dominant handgrip strength and eight anthropometric variables, viz. height, weight, body mass index, upper arm length, forearm length, total arm length, upper arm circumference and humerus biepicondylar diameter were measured on all the subjects. One way analysis of variance showed significant between group differences ($p \leq 0.001$) in all the variables studied between the kabaddi players and controls. Significant correlations ($p \leq 0.001$) of dominant and non-dominant handgrip strength were found with all the anthropometric variables studied both in male and female players. In conclusion it may be stated that handgrip strength can be used as a strong determining factor in the success in the game of kabaddi.*

Keywords: Handgrip strength. Anthropometric variables. Indian junior kabaddi players. Performance enhancement.

INTRODUCTION

Kabaddi is the team-contact 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 is basically a combative sport, played between two teams for a period of 40 minutes with a 5 minute break and requires 7 players in each team (minimum 10 players and maximum

12 players; 7 in the court and rest are substitutes). 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).

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).

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).

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).

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 correlations of handgrip strength and anthropometric characteristics in kabaddi players are limited. So the present study was planned. In the present study, an attempt was made to evaluate the correlations and comparisons of the anthropometric variables in junior level kabaddi players of both the sexes. This data would help to set guidelines in the selection of future kabaddi players and to attain the physique related status for enhancing the performance of the players. Not much literature is available in this regard, so the present study was planned.

MATERIALS AND METHODS

Participants

The present cross-sectional study was based on 129 junior level (under 19 years) kabaddi players (67 boys and 62 girls) aged 12 – 18 years selected purposively from different schools of Muktsar, Punjab. An adequate number of controls (n=125, 64 males and 61 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 school 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 ethics committee.

Anthropometric measurements

Eight anthropometric variables, viz. height (HT), weight (WT), body mass index (BMI), upper arm length (UAL), forearm length (FAL), total arm length (TAL), upper arm circumference (UAC), humerus biepicondylar diameter (HBD), and dominant handgrip strength (DHGS) and non-dominant handgrip strength (NDHGS) 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 length, forearm length and total arm length were measured by the first segment of anthropometer in centimeter. Upper arm circumference was measured by steel tape in centimeter and humerus biepicondylar diameter was measured by sliding caliper in centimeter.

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.

Statistical analysis

Standard descriptive statistics (mean \pm standard deviation) were determined for directly measured variable. One way analysis of variance was tested for the comparisons of data among Indian junior level 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.

RESULTS

Table1. One way ANOVA of handgrip strength and selected anthropometric variables in kabaddi players and controls

Variables	Male kabaddi players (n=67)		Female kabaddi players (n=62)		Control males (n=64)		Control females (n=61)		F- value	p- value
	Mean	SD	Mean	SD	Mean	SD	Mean	SD		
Weight (kg)	49.98	7.23	44.12	4.53	48.98	11.93	43.57	6.67	9.980	< 0.001
Height (cm)	161.73	7.59	157.27	4.70	161.65	11.04	153.49	5.76	15.983	< 0.001
Body Mass Index (kg/m ²)	19.01	1.65	17.82	1.52	18.54	3.18	18.49	2.35	2.775	< 0.042
Upper arm length (cm)	30.68	2.34	27.95	2.02	31.73	2.99	30.38	1.83	28.203	< 0.001
Forearm length (cm)	29.78	2.12	25.40	1.36	25.02	2.40	23.13	1.46	133.186	< 0.001
Total arm length(cm)	75.00	4.69	70.83	2.82	74.65	6.04	70.29	3.48	18.738	< 0.001
Upper arm circumference (cm)	25.12	12.81	21.98	2.21	24.19	4.03	22.77	2.30	15.899	< 0.001
Humerus biepicondylar diameter (cm)	6.76	0.52	5.79	0.38	6.60	0.77	5.92	0.34	50.620	< 0.001
Dominant handgrip strength (kg)	36.17	7.60	19.31	4.74	29.14	8.79	20.45	3.80	87.517	< 0.001
Non-dominant handgrip strength (kg)	34.67	7.94	17.62	4.22	27.95	9.57	18.82	4.02	82.289	< 0.001

Descriptive statistics of handgrip strength and selected anthropometric variables in Indian junior level kabaddi players and controls were shown in Table 1. Male kabaddi players have higher mean value in dominant and non-dominant hand grip strength (36.17 kg and 34.67 kg respectively) than their female counterparts (19.31 kg and 17.62 kg respectively) and also than their control counterparts (29.14 kg and

27.95 kg respectively). Female kabaddi players also had higher mean value for this trait than their control counterparts (20.45 kg and 18.82 kg

Table 2. Pearson's correlation coefficients of handgrip strength and selected anthropometric variables in male and female kabaddi players

Variables	HT	WT	BMI	UAL	FRL	TAL	UAC	HBD	DHGS	NDHGS
HT	1	0.830**	0.307*	0.716**	0.539**	0.753**	0.538**	0.497**	0.694**	0.696**
WT	0.596**	1	0.782**	0.609*	0.512*	0.690**	0.558**	0.596**	0.830**	0.851**
BMI	-0.003	0.799**	1	0.245	0.275*	0.344*	0.370*	0.463*	0.656**	0.678**
UAL	0.441**	0.362*	0.126	1	0.757**	0.800**	0.564**	0.505**	0.435**	0.438**
FRL	0.463**	0.374*	0.121	0.405**	1	0.762**	0.407**	0.313*	0.375*	0.408**
TAL	0.778**	0.499**	0.030	0.749**	0.545**	1	0.566**	0.501**	0.511**	0.564**
UAC	0.309*	0.524**	0.416**	0.507**	0.105	0.413**	1	0.615**	0.518**	0.497*
HBD	0.112	0.088	0.021	0.236*	0.445**	0.288*	0.162	1	0.553**	0.540**
DHGS	0.440**	0.364*	0.188	0.296*	0.275*	0.421**	0.352*	0.138	1	0.935**
NDHGS	0.481**	0.382*	0.129	0.325*	0.336*	0.508**	0.243	0.119	0.830**	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, UAL= upper arm length, FRL= forearm length, TAL= total arm length, UAC= upper arm circumference, HBD= humerus biepicondylar diameter, DHGS= dominant handgrip strength and NDHGS= non-dominant handgrip strength.

respectively). One way analysis of variance showed significant between-group differences ($p < 0.042 - 0.001$) 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 with all the anthropometric variables studied. However, significant sex differences ($p \leq 0.01$) were noted in all the variables studied in the junior level kabaddi players.

Table 2 showed the bivariate correlations of handgrip strength with selected anthropometric variables in Indian junior level kabaddi players. Dominant handgrip strength had significantly positive correlations ($p \leq 0.01$) with all the variables studied (except BMI and HBD), whereas non-dominant hand grip

strength had significantly positive correlations ($p \leq .01$) with all the variables studied (except BMI, UAC and HBD) in kabaddi females. Dominant hand grip strength and non-dominant hand grip strength had significantly positive correlations ($p \leq .001$) with all the variables studied in kabaddi males. Among the anthropometric variables, significantly positive correlations were noted in almost all the variables.

DISCUSSION

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).

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 movement become quicker. On the other hand in physical skills speed, power, strength, endurance, flexibility, swift action, and proper coordination between hand eyes and limbs. If your body is flexible then only you can kick, swirl grapple with ankle legs and things. Here more than speed acceleration is paramount; 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 involve 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.

The results of the present study demonstrated significant differences ($p < 0.001$) of dominant and non-dominant handgrip strength with selected anthropometric variables both 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 in kabaddi players. These differences were probably due to structural and physiological variations between the two sexes. The greater values of hand grip strength in kabaddi males may be due to greater muscle mass than the female kabaddi players. In the present study, significant positive correlations ($p < 0.004-0.001$) of dominant and non-dominant handgrip strength were found with all the anthropometric variables studied. 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. 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. (2003) observed that hand grip strength correlated with throwing speed in experienced pitchers. Though, later in (2001) they showed no significant relationship among the strength variables and ball speed during the tennis serve.

However, significant positive correlations were noted among the anthropometric variables too in the present study. Majlesi et al. (2012) studied correlation between anthropometric and physical fitness traits through a case study in Hamedan kabaddi team and found that arm span of the subject was 2 cm more than his height. Dey et al. (1993) conducted morphological and physiological studies on Indian national kabaddi players and concluded that a mesomorphic endomorph physique will suit sports like kabaddi as well as aerobic and anaerobic capacity measured in study were higher than that of normal sedentary persons but not satisfactory as compared with other games. Patel et al. (2014) conducted a study to review on selected physical and physiological components of inter collegiate kabaddi and kho-kho players and concluded that the kabaddi players have greater explosive strength depicting significant inter-relationship between anthropometric and physical components. Mangesh (2012) showed that medium statured players achieved success more often than the shorter and taller players. From the analyzed data, the researcher found that, in hand touch skill, short and medium statured players attempted the skill more often in comparison to the tall players. With reference to the findings of the toe touch skill, the medium height players were found to be using this skill more number of times than the others. Here, the players are taking advantage of their height and speed to make the antis out with the help of leg. About kick only medium height player are using this skill may be they are getting advantage of both, short for running and tall for long strides.

The findings of the present study have immense practical application in identification of talent with reference to their particular anthropometric parameters in junior level kabaddi players. It would be helpful in terms of optimizing training programs specific to the requirement of game of kabaddi. The findings of the present study would be helpful to keep the injury of the players at bay.

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