Correlations of Handgrip Strength with Selected Anthropometric Variables and Flexibility Measure in Indian Inter-university Handball Players

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Abstract: The purpose of this study was of two-fold: firstly to estimate the handgrip strength of Indian inter-university handball players and, secondly to search the correlations of it with selected anthropometric variables and flexibility measure. To serve this purpose, a total of eight anthropometric variables, such as height, weight, body mass index, upper arm length, forearm length, total arm length, hand length and hand breadth, flexibility measure such as, sit and reach test, and right and left handgrip strength were measured on purposely selected 150 Indian inter-university handball players aged 18-25 years collected from the inter-university competition held in Guru Nanak Dev University, Amritsar, India during September, 2013. An adequate number of controls ($n = 102$) were also taken from the same place for comparisons. The results showed statistically significant between-group differences ($P \leq 0.006-0.001$) among the male and female handball players and controls in all the variables studied. Statistically significant positive correlations ($P \leq 0.023-0.001$) of both right and left handgrip strength were found with all the variables studied, except BMI, in Indian inter-university handball players. In conclusion, it may be stated that handgrip strength may be used as one of the indicating factors for physical strength as well as the flexibility measure of the handball players.

Key words: Handgrip strength, anthropometric variables, physical fitness tests, Indian inter-university handball players.

1. Introduction

Handball is a team game. It requires a high standard of preparation to achieve success [1]. The movement patterns of this game are characterized as intermittent and they change continuously in response to different offensive and defensive situations. Anthropometric and morphological characteristics can influence the effectiveness of such responses, as has been observed in other sports [2]. In handball, players require to have well developed aerobic and anaerobic capacities [3]. Anthropometry has been defined as the measurement of morphological parameters of human [4]. It was reported that a battery of anthropometric and morphological tests could distinguish between players of different ability in the same sport [5-7].

Handgrip strength is often used as an indicator of overall physical strength of an individual [8], hand and

forearm muscles performances [9], as a functional index of nutritional status [10-15] and physical performance [16]. 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 [11, 12, 17-21].

Some literature related to the handgrip strength, morphological and anthropometric variables of handball players are available [22-26]. Literature related to its association of handgrip strength with anthropometric variables in handball players is scanty, especially in Indian context. Thus, the present study was planned with the objectives to estimate the handgrip strength and its correlations with selected anthropometric variables and flexibility measure in inter-university handball players of both the sexes.

2. Materials and Methods

The present cross-sectional study was based on purposely selected 150 inter-university level handball players (75 males, mean age 18.6 ± 0.7 years and 75 females, mean age 18.9 ± 1.03 years) aged 18-25 years from the inter-university competition organized in Guru Nanak Dev University, Amritsar, Punjab, India in March, 2014. An adequate number of controls ($n = 102$, 52 males, mean age 22.4 ± 1.69 years, and 50 females, mean age 20.8 ± 2.25 years). The age of the subjects were recorded from the date of birth registered in their respective records submitted to the authorities. 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.

2.1 Anthropometric Measurements

Eight anthropometric variables, such as height (HT), weight (WT), body mass index (BMI), upper arm length (UAL), forearm length (FAL), total arm length (TAL), hand length (HL), hand breadth (HB) were measured on each subject using standard techniques [27].

The height was recorded during inspiration using a stadiometer (Holtain Ltd., Crymych, Dyfed, UK) to the nearest 0.1 cm. 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 was measured by first segment of anthropometer in centimeter. Hand length and hand breadth was measured by sliding caliper in centimeter.

2.2 Handgrip Strength Measurement

The grip strength of both right and left 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 with 30 seconds recovery period from both sides of the hands. The maximum value was recorded in kilograms.

2.3 Flexibility Measure (Sit and Reach Test)

Sit and reach test was used to estimate back and hamstring flexibility. The players performed warm up for 10 minutes and then removed their shoes for test. The researcher secured the ruler to the box top with the tape so that the front edge of the box lined up with the zero-mark on the ruler and the zero-end of the ruler pointed towards the player. The players were asked to sit on the floor with their legs fully extended with the bottom of their bare feet against the box. The players placed one hand on top of the other, slowly bent forward and reached along the top of the ruler as far as possible holding the stretch for two seconds. The researcher recorded the distance reached by the players' finger tips in cm. The players performed the test thrice. The researcher then calculated and recorded the average of the three distances and assessed the players' performance.

2.4 Statistical Analysis

Standard descriptive statistics (mean $\pm$ standard deviation) were determined for directly measured variables. One way analysis of variance was tested for the comparisons of data among inter-university handball players. Pearson's correlation coefficients were applied to establish the correlations of right and left handgrip strength with the variables measured. Data were analyses using SPSS (Statistical Package for Social Science) version 17.0. A 5% level of probability was used to indicate statistical significance.

3. Results

Table 1 showed the descriptive statistics of

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anthropometric variables and flexibility measure in inter-university handball players and controls. The one way analysis of variance of handgrip strength, anthropometric variables and flexibility measure tests showed statistically significant between-group differences ($P < 0.006-0.001$) in all the variables studied. Significant sex differences ($P < 0.023-0.001$) were also noted in all the variables studied both in handball players and controls.

The correlation coefficients of right and left handgrip strength with the selected anthropometric variables and flexibility measure in inter-university handball players were shown in Table 2. In the players, significantly positive correlations ($P < 0.001$) of both

right and left handgrip strength were found with all the variables studied, except BMI. In controls, significantly positive correlations ($P < 0.023-0.001$) of right and left handgrip strength were noted with all the variables studied, except upper arm length with left handgrip strength.

4. Discussion

Ball games require comprehensive ability including physical, technical, mental, and tactical abilities. Among them, physical abilities of players exert marked effects on the skills of the players themselves and the tactics of the team, because ball games demand repeated maximum exertion such as running and throwing.

Table 1 One way ANOVA of handgrip strength, anthropometric variables and flexibility measure in Indian inter-university handball players.

Variables	Male handball players ($n = 75$)		Female handball players ($n = 75$)		Male controls ($n = 52$)		Female controls ($n = 50$)		F value	P value
	Mean	SD	Mean	SD	Mean	SD	Mean	SD		
HT (cm)	171.43	5.55	161.15	5.88	170.62	5.87	159.17	6.05	72.843	0.001
WT (kg)	62.60	7.13	87.15	3.26	64.37	11.02	51.83	8.96	29.739	0.001
BMI	21.28	2.39	21.99	1.19	22.15	3.55	20.46	3.80	4.295	0.006
UAL (cm)	34.36	1.88	29.21	1.20	28.77	2.91	28.19	2.49	124.399	0.001
FAL (cm)	32.58	1.89	27.15	0.95	27.71	3.47	26.04	1.87	126.600	0.001
TAL (cm)	86.36	2.13	71.48	2.11	75.04	3.82	70.82	3.75	429.222	0.001
HL (cm)	19.42	2.62	15.12	1.58	19.02	0.70	17.03	0.87	90.913	0.001
HB (cm)	8.19	0.30	7.01	0.22	8.55	0.40	7.49	0.37	296.270	0.001
S&RT (cm)	15.51	1.71	11.71	3.40	6.19	6.07	0.66	8.13	100.703	0.001
RHGS (kg)	36.47	5.02	24.56	4.62	41.11	6.57	24.25	4.24	163.034	0.001
LHGS (kg)	37.22	4.50	23.35	5.38	38.61	6.39	22.45	4.18	174.270	0.001

HT = height, WT = weight, BMI = body mass index, UAL = upper arm length, FAL = forearm length, TAL = total arm length, HL = hand length, HB = hand breadth, S&RT = sit and reach test, RHGS = right handgrip strength and LHGS = left handgrip strength.

Table 2 Correlation coefficients of right and left handgrip strength with anthropometric variables and flexibility measure in handball players.

Variables	Right handgrip strength				Left handgrip strength			
	Handball players		Controls		Handball players		Controls	
	<i>r</i>	<i>P</i>	<i>r</i>	<i>P</i>	<i>r</i>	<i>P</i>	<i>r</i>	<i>P</i>
HT	0.666	0.001	0.704	0.001	0.687	0.001	0.685	0.001
WT	0.506	0.001	0.603	0.001	0.529	0.001	0.628	0.001
BMI	-0.110	0.180	0.293	0.003	-0.104	0.205	0.328	0.001
UAL	0.745	0.001	0.218	0.028	0.857	0.001	0.132	0.186
FAL	0.752	0.001	0.321	0.001	0.768	0.001	0.327	0.001
TAL	0.500	0.001	0.780	0.001	0.466	0.001	0.801	0.001
HL	0.478	0.001	0.656	0.001	0.505	0.001	0.643	0.001
HB	0.757	0.001	0.691	0.001	0.795	0.001	0.398	0.001
S&RT	0.552	0.001	0.396	0.001	0.588	0.001	0.388	0.001

Therefore, players must have the physical abilities to make rapid and powerful movements along with aerobic and anaerobic capacities that make them competent in prolonged vigorous offensive and defensive maneuvers [28].

Handball is one of the team sports in the Olympic Games. It requires a high standard of physical endurance in order to compete 60 minutes of highly competitive play and to excel the performance [3]. In handball, movement patterns are characterized as intermittent and change continuously in response to different playing situations. Anthropometric and morphological characteristics can obviously influence the effectiveness of such responses [28-31].

In the present study, one way analysis of variance showed statistically significant between-group differences of right and left handgrip strength with selected anthropometric variables and flexibility measure. When comparisons were made between the players and their control counterparts, both in male and female players, significant differences were observed in almost all the variables studied. These differences were probably due to the effect of regular physical exercise and vigorous training program in handball players. Further, significant sex differences were found in all the variables in the handball players. These differences were probably due to structural and functional differences between two sexes.

Significant positive correlations of both right and left handgrip strength were found with all the variables studied. Such type of correlations of handgrip strength with anthropometric variables and performance tests were also reported in other sports too [18-21]. In fact, all the hand and arm muscles are responsible for the generation of handgrip force and, the hand and arm anthropometry has a close affinity to handgrip strength [32]. In the present study, small sample size was a limitation which would be taken into account in our future studies.

5. Conclusions

The findings of the present study have immense practical application in selection of talents in handball players. It would be beneficial to the handball players in term of optimizing training programs separately for male and female players.

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