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ORIGINAL ARTICLE

CORRELATION OF HANDGRIP STRENGTH WITH ARM ANTHROPOMETRIC VARIABLES IN CRICKETERS

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ABSTRACT

OBJECTIVE: To estimate correlation of handgrip strength with arm anthropometric variables of dominant side.

METHODS: This cross-sectional study was conducted on 241 male cricketers from July 2017 to August 2018 in Lahore using convenient sampling. Arm anthropometric variables and handgrip strength of dominant side were measured by standard anthropometric techniques & formulas. Pearson correlation coefficient & linear regression analysis were applied to find out extent of relationship.

RESULTS: Mean age of 241 players is 25.19±3.493 years. Out of 241 players, 74 (30%) players were batsmen, 69 (29%) were bowlers, 14 (6%) were wicket keepers and 84 (35%) were all-rounder players. Mean handgrip strength of study participants was 65.783±3.365 kg. Mean values for various anthropometric variables included triceps skinfold thickness (13.807±0.815 mm), subscapular skinfold thickness (16.552±0.763 mm), mid arm circumference (33.398±1.274 cm), arm muscle area (67.381±5.149 cm^2), arm muscle girth (29.070±1.116 cm), arm area (88.986±6.643 cm^2), arm fat area (21.605±1.836 cm^2), and arm fat index (24.281±1.055). Handgrip showed positive correlation with triceps skinfold (r=0.608, p=<0.001), mid-arm circumference (r=0.738, p=<0.001), upper arm muscle area (r=0.694, p=<0.001), upper arm muscle girth (r=0.695, p=<0.001), total arm area (r=0.740, p=<0.001), upper arm fat area (r=0.728, p=<0.001), subscapular skinfold (r=0.215, p=0.001), and arm fat index (r=0.158, p=0.013).

CONCLUSION: All the anthropometric variables had a positive significant correlation with handgrip strength. Handgrip strength is standard indicator to achieve target of excellent performance as well as can be made a valuable criterion of selection for cricket & multiple games involving grip.

KEY WORDS: Anthropometry (MeSH); Hand Strength (MeSH); Cricketers (Non-MeSH).

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INTRODUCTION

Handgrip strength is referred as muscular strength and power that a person can generate with hand. Biomechanically handgrip strength results from flexion of joints of finger and thumb with greatest voluntary effort that a person has ability to exert under standard biokinetic conditions using musculature of forearm and hand.[1] It is an established fact that selection of a sportsman is made on basis of physique and body measurements so in sports sciences, tradition of using anthropometry is very rich.[2] Structural assessment of a sportsman includes anthropometric measurements, which is termed as objective measurement of human body structure in terms of dimensions of bones, muscles and soft tissues for example height, weight, and circumference of body parts including limbs.[2] Assessment of handgrip strength is of substantial importance in determination of efficacy of various treatments strategies in hand rehabilitation as well, as it is used as an indicator of upper limb strength as part of assessment & prognostic indicator,[3] forearm and hand muscles performance[4] and also denoted as functional index of a person's nutritional status,[5] a marker of subjective global assessment, and as outcome of nutritional index in assessing malnutrition.[6] Similarly researches concerning the performance of sports persons on scientific & biomechanical basis has been increasing tremendously to achieve excellence of performance in a number of games. Scientists use these findings to find relationship between human body structure and specified body functions needed for multiple tasks.[7] Arm and forearm generate ample force with the contraction of the shoulder, scapular, arm & forearm muscles. Arms act like a leverage and the integrity of the shoulder and elbow complexes completes the anticipated task. To attain uttermost performance in game accompanying high level of skill required to play Cricket, there must be ideal balance between mobility and stability. This variable handgrip strength is also influenced by individual's customized factors including age, sex and physique. Another study indicated strong correlations between grip strength and different anthropometric characteristics as weight, height, hand length and so forth.[8]

A study on Indian domestic level cricketers showed that cricketers have

Figure 1: Triceps skinfold measurement

Figure 2: Subscapular skinfold measurement

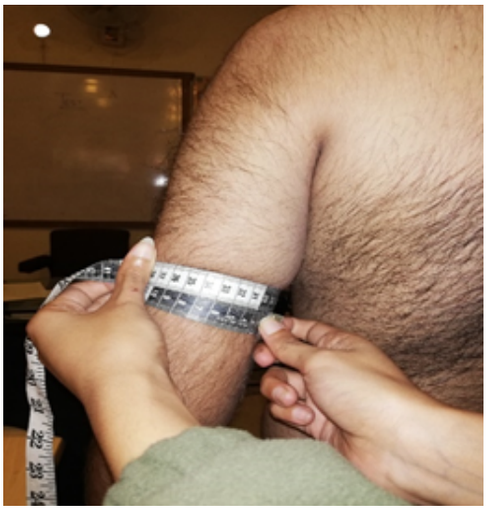

Figure 3: Mid arm circumference measurement

Figure 4: Handgrip strength measurement

higher mean values in both right and left handgrip strength, height skinfold of triceps muscle, arm muscle area and lean body mass as compare to their counterparts. Other arm anthropometric variables including arm muscle girth, arm area, arm fat area, arm fat index and weight, body mass index (BMI) and percent of body fat was found lesser. They also showed characteristic findings of height, lean body mass, arm muscle area, handgrip strength help the cricketers to produce more force according to desired role in game.[2] Another study on Indian inter-university female volleyball players showed that dominant handgrip strength had strong positive correlations with all the variables studied in Indian interuniversity female volleyball players.[9]

Pakistan is a cricket loving country and is a former world champion of cricket. However, sports medicine is not developed at gross root level and very limited research has been conducted on the anthropometric measurements and fitness level of cricketers in Pakistan.[10,11]

This study was planned at to evaluate correlation of handgrip strength with arm anthropometric variables of dominant side. Such studies can be beneficial in exploration of future players, best player selection, talent identification, evaluation of fitness components, designing and progress of training strategies, utilization of batsmen, bowlers, and fielders during game to excerpt maximal performance & as a part of post injury rehabilitation maneuvers as well.

TABLE I: ANTHROPOMETRIC MEASUREMENTS OF CRICKETERS

Variables	Mean ± SD
Triceps skinfold thickness (mm)	13.807±0.815
Subscapular skinfold thickness (mm)	16.552±0.763
Mid arm circumference(cm)	33.398±1.274
Arm muscle area (cm^2)	67.381±5.149
Arm muscle girth (cm)	29.070±1.116
Arm area (cm^2)	88.986±6.643
Arm fat area (cm^2)	21.605±1.836
Arm fat index	24.281±1.055
Handgrip strength (kilograms)	65.783±3.365

TABLE II: REGRESSION ANALYSIS OF HANDGRIP STRENGTH & ARM ANTHROPOMETRIC MEASUREMENTS

Variables	r	P-value	Adjusted R^2
Triceps skinfold thickness	0.608	<0.001	0.543
Subscapular skinfold thickness	0.215	0.001	0.042
Mid arm circumference	0.738	<0.001	0.543
Upper arm muscle area	0.694	<0.001	0.480
Arm muscle girth	0.695	<0.001	0.482
Total arm area	0.740	<0.001	0.545
Upper arm fat area	0.728	<0.001	0.529
Arm fat index	0.158	0.013	0.021

METHODS

This cross-sectional study was conducted on a sample size of 241 players, calculated using Raosoft online software from a population size of 11589 (calculated in a pilot study) people using non-probability convenient sampling technique. Data was collected from registered cricket clubs, coaching clubs, academies in Lahore after getting permission from management. Only right handed & male cricketers with age group between nineteen to thirty years were recruited. Cricketers having previous history of wrist injury & recent history of trauma to upper limbs were excluded from study. Data was collected from July 2017 to August 2018 through a semi-structured questionnaire, which had three parts, demographic data, all variables of arm anthropometric variables, and handgrip strength measurement. Arm anthropometric variables and handgrip strength of dominant side were measured by standard anthropometric techniques & formulas.[2]

Skinfolds i.e. Triceps and subscapular skinfold were measured in millimeters using Slim Guide Skinfold Caliper. Before each measurement session, the caliper's pointer had been zeroed & measurement was recorded when pointer slowed down & remained at a point.[12]

Triceps skinfold was measured when player was in erect standing position with relaxed shoulders. Point on the dorsal surface of upper arm was marked[13] as illustrated in figure 1.

Subscapular skinfold was measured when player was in erect standing position with feet together & shoulders relaxed as well as arms were hanging freely. Inferior angle of the scapula was marked & fold of skin below 1.0 cm was grasped medially & diagonally towards the elbow[13] as illustrated in figure 2.

Mid arm circumference was measured when player was in standing position with the elbow relaxed so that arms were hanging freely. The measuring tape put around arm's upper part at a point which was perpendicular to long axis of arm[13] as illustrated in figure 3.

Anthropometric calculations of arm muscle girth, arm muscle area, arm area, arm fat area of arm & arm fat index were done by putting obtained value of mid-arm circumference into standard formulas.[13]

Handgrip strength was measured by squeezing handgrip dynamometer by dominant hand as tightly as possible in standing position while shoulder was in adduction and neutrally rotated & elbow was in extension[2] with measuring unit in kilogramsas illustrated in figure 4. Camry hand 200 Lbs / 90 Kgs Digital Hand Dynamometer was used. Three values of handgrip strength were taken for each player after giving them warm up & trial. Afterwards mean value was calculated.[2]

IBM SPSS (Statistical Package for Social Science) version 21.0 was used for entry and analysis of collected data. Calculation of arm anthropometric variables was done using Microsoft excel 2010. Descriptive statistics were applied for all the directly measured and derived variables. Pearson's correlation coefficient was used to observe correlation between arm anthropometric variables and handgrip strength and scatter plots were also generated.

RESULTS

According to findings of study cricket players enrolled in this study had mean age of 25.19±3.493 years, while mean handgrip strength was 65.783±3.365 kg. Out of 241 players, 74 (30%) players were batsmen, 69 (29%) were bowlers, 14 (6%) were wicket keepers and 84 (35%) were all-rounder players. Pearson's correlation coefficient was applied between handgrip strength and arm anthropometric variables and skinfolds. It was found that triceps skinfold (r=0.608, p=<0.001), mid arm circumference (r=0.738, p=<0.001), upper arm muscle area (r=0.694, p=<0.001), arm muscle girth (r=0.695, p=<0.001), total arm area (r=0.740, p=<0.001, and upper arm fat area (r=0.728, p=<0.001) have significantly strong positive linear relationship with handgrip strength. Similarly subscapular skinfold (r=0.215, p=0.001) had weak linear correlation with handgrip strength while arm fat index (r=0.158, p=0.013) had very weak linear correlation with handgrip strength. Figure 5 shows the scatterplot of handgrip strength & arm anthropometric variables.

DISCUSSION

Physical fitness is vital for cricket, a game requiring maximal endurance & maximal strength, ranging from bowling, throwing the ball during fielding and batting, involving maximal use of arm & forearm strength. Results of the study indicate that among cricketers, handgrip strength has a positive linear correlation with various arm anthropometric variables. Triceps skinfold (r=0.608, p=<0.001), mid arm circumference (r=0.738, p=<0.001),

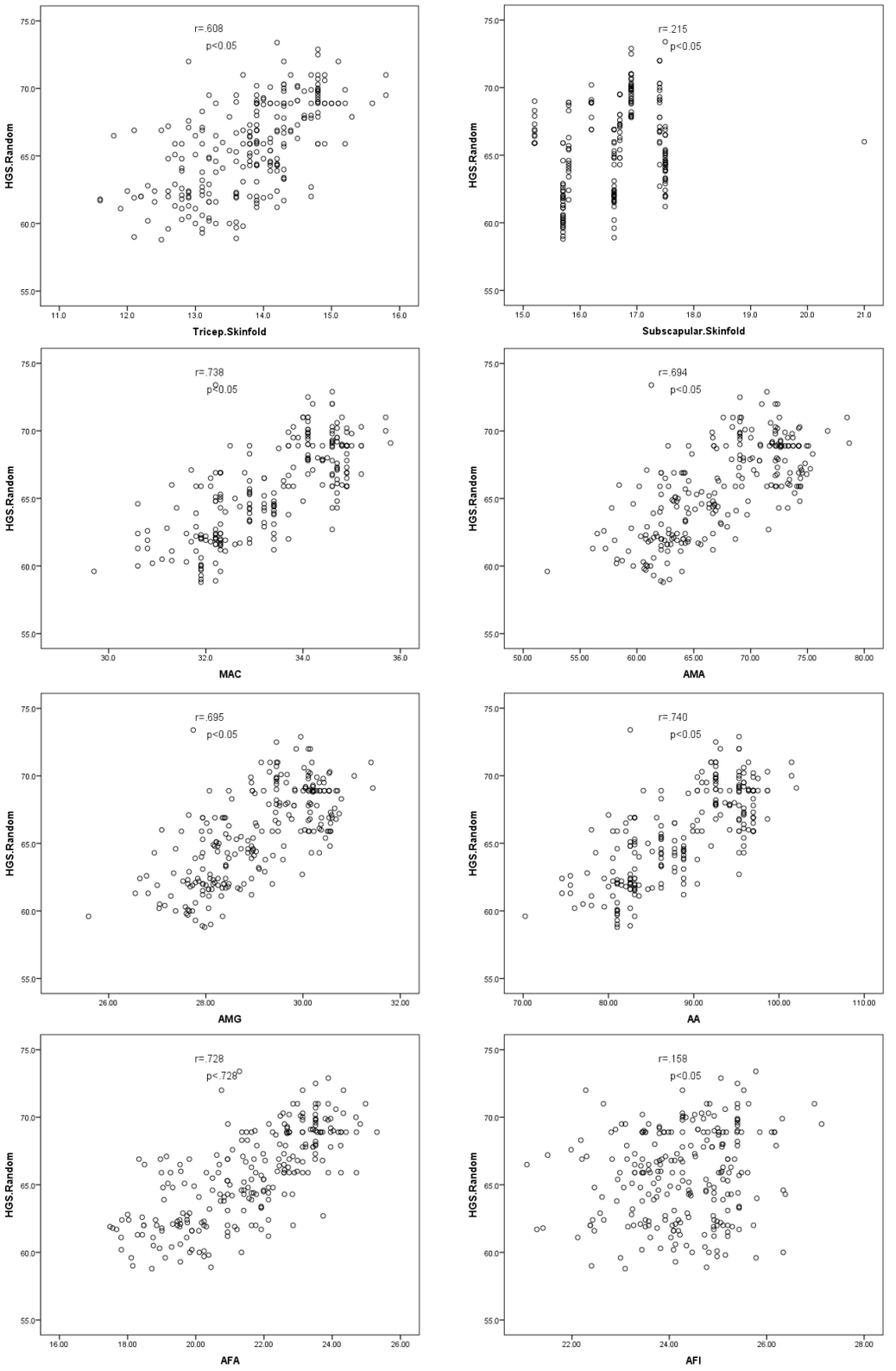

Figure 5: Scatter plot drawn among handgrip strength & arm anthropometric variables [HGS (Handgrip strength), AMA (Arm muscle area), MAC (Mid arm circumference), AA (Arm Area), AFA (arm fat area), AFI (Arm fat index), AMG (Arm muscle girth)]

upper arm muscle area (r=0.694, p=<0.001, arm muscle girth (r=0.695, p=<0.001), total arm area (r=0.740, p=<0.001) and upper arm fat area (r=0.728, p=<0.001) had significantly strong positive relationship with dominant hand grip strength. However, subscapular skinfold (r=0.215, p=0.001) had weak correlation and arm fat index (r=0.158, p=0.013) had very weak correlation with handgrip strength.

Increased area of arm muscle and strength of handgrip aid the cricketers to generate maximum power during desired action. Scatter plots in regressions analysis revealed that triceps skinfold had moderate, subscapular skinfold had weak, mid arm circumference, arm muscle area, arm muscle girth, total arm area, upper arm fat area had strong positive, while arm fat index had very weak linear relationships with handgrip strength.

According to a study of 2009, conducted in India, right handgrip 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).[2] These results are also supporting this study's findings. Similarly another cross-sectional survey which involved 110 purposively selected undergraduate athletes showed that there was a significant positive correlation between Handgrip and lean muscle mass (LMM) (r=0.670, p=<0.001), weight (r=0.492, p=<0.001), height (r=0.521, p=<0.001) and energy intake (r=0.386, p=0.00) while significant negative correlation between handgrip and percentage body fat (r=-0.400, p=<0.001) was also narrated.[14]

Another study was conducted in Amritsar, Punjab, India that was based on assessment of association of handgrip strength with eight anthropometric traits, viz. height, weight, body mass index, hand length, hand breadth, upper arm length, forearm length and total arm length in 100 male cricketers aged 17 - 21 years. A total of 100 controls were also recruited in the study for comparisons. The findings of this study indicated strong association of right handgrip strength with height (r =0.383), weight (r=0.498), body mass index (r=0.401), hand length (r=0.444), hand breadth (r=0.326) and forearm length (r=0.215). Whereas left handgrip strength was associated with height (r=0.355), weight (r=0.472), body mass index (r=0.374), hand length (r=0.320) and hand breadth (r=0.330).[2]

Another study conducted in Guru Nanak Dev University, Amritsar, Punjab in India was done in which randomly selected 63 inter-university Indian volleyball players (38 males and 25 females) aged 18–25 years alongside controls (n = 102, 52 males and 50 females) were taken. Objective of this study was to find out correlations of BMI and percent body fat, right handgrip strength with other arm anthropometrics characteristics. According to anthropometric findings of study, upper arm length (r=0.417), lower arm length(r=0.776), total arm length(r=0.747), arm circumference (r=0.618), arm muscle area (r=0.833), upper arm area(r=0.620) &upper arm bone free muscle area (r=0.796) all had strong positive linear relationship with right handgrip strength while upper arm fat area (r=-0.315) & arm fat index (r=-0.696) had negative relationship with right handgrip strength.[15]

Another study was conducted in 2011 duringthe Inter-university Championship organized at Guru Nanak Dev University, Amritsar, India to evaluate the association of handgrip with arm anthropometric characteristics in Indian inter-university basketball players. Sixty Indian inter-university basketball players aged 18-25 years of six participant universities were taken as sample. The results indicated significant positive correlations among the arm anthropometric characteristics i.e.upper arm length, forearm length and total arm length studied while arm fat area and arm fat index had very weak correlation with right and left handgrip strength.[16,17]

Similarly, another study was conducted in 2009 in India on male university students & according to results of study it was found that hand dominance had positive correlations with anthropometric variables of arm. Results indicated a strong association of dominant right handgrip strength with all the anthropometric variables, except biceps skinfold. Statistically significant positive correlations were observed between dominant left handgrip and hand breadth (p = 0.464), upper arm circumference (r = 0.570), forearm circumference (p = 0.464) and triceps skinfold (p = 0.343).[18]

According to existing literature, handgrip and anthropometric variables among cricketers have not been under consideration in previous years similarly data is not available or is unpublished according to my knowledge, regarding the association of handgrip with physical traits among cricketers while the same data in volleyball is enormous. Anthropometric calculations along with hand strength assessment can be of ample use in cricket and other games as well as valuable in ranking of players in different spells to excerpt their performances at maximal level, in talent identification & designing and progress of training strategies for cricketers.

CONCLUSION

The findings of the study indicated that, among desired anthropometric variables, cricketers have linear positive relationship of triceps skinfold, subscapular skinfold, arm muscle area, arm muscle girth, arm area, arm fat area and arm fat index with handgrip strength of same limb, showing statistically significant differences. All of these variables especially increased area of the arm muscle as well as handgrip strength aid the cricketers to produce additional force.

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AUTHORS' CONTRIBUTIONS

Following authors have made substantial contributions to the manuscript as under:

HS: Conception and study design, acquisition, analysis and interpretation of data, drafting the manuscript, final approval of the version to be published

AJ: Analysis and interpretation of data, critical review, final approval of the version to be published

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

CONFLICT OF INTEREST

Authors declared no conflict of interest

GRANT SUPPORT AND FINANCIAL DISCLOSURE

NIL

DATA SHARING STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request

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