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RESEARCH ARTICLE

Correlation of lean body mass, hand grip strength in football and cricket players: A cross-sectional study

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ABSTRACT

Background: Hand grip strength (HGS) and percentage of lean body mass has been an indicator for determining strength. **Aims and Objectives:** The purpose of the study was to found out for comparison of percentage of lean body mass in cricket and football player. We also have done a correlation of HGS with percentage of lean body mass in cricket and football players. **Material and Methods:** Total 30 healthy cricket and football players (15-25 years), from district sports academy, regularly practicing from last 3 years at university level and who do not have any abnormality of the upper arm or any neurological problem, history of fracture of hand were included. Percentage of lean body mass calculated by formula = 100 − Percentage of body fat. Percentage of body fat determined by harpendence caliper. Measurement of HGS with the help of Sahen's hand grip digital dynamometer was done. Mean of three reading was taken as final reading. Unpaired test was applied for the comparison between cricketers and football players for the variables of percentage of lean body mass. Pearson correlation coefficient established a correlation of percentage of lean body mass with HGS. **Results:** It was also found that statistically there was a highly significant difference observed in percentage of lean body mass between cricket and football players and there was positive correlation observed between HGS with percentage of lean body mass in cricket and football players. **Conclusion:** Proper training for maintaining percentage of lean body mass and HGS will increase in HGS. It will further lead to better strength and performance in cricket and football activities.

KEY WORDS: Anthropometry; Dynamometry; Harpendence Caliper; Handgrip Strength; Percentage of Body Fat; Percentage of Lean Body Mass

INTRODUCTION

A sport is a worldwide phenomenon. It has become an interesting aspect for human amusement and a cultural phenomenon of great magnitude and complexity. It has got mass participation, as it attracts people either for recreation, physical fitness or for profession. Sports are organized at competitive levels since ancient times but now competition in sports has achieved the highest level. Hundreds of young aspirants are devoting time and energy for achieving success in these events. Among sports, cricket and football are more popular as it is great fun and people of all ages can enjoy it. Many studies have shown that specific anthropometric characteristics are significantly associated with success in sports.[1] Therefore, understanding the body composition of top level athletes and then competitive weights for the athletes has been done for decades and is considered an essential part of the total management process.[2] Scientists all over the world are looking for a standard formula that can improve the performance of elite players and discover talents as

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efficiently as possible.[3] Since each sport has its own specific demands, every athlete should have specific anthropometrical characteristics and body composition figures for his or her own sports discipline. Anthropometric dimensions like lean body mass percentage and hand grip strength (HGS) play an important role in cricket and football. Many scientist have done a research on anthropometric parameters of cricket players and HGS in them.[4,5]

Contemporary sports science is designed to improve the performance of elite players and to discover talents as precisely as possible. Percentage of lean body mass is different in cricket and football. We can evaluate demand of each sport by doing comparison of it. We can plan training programs for improvement of these parameters.

HGS has been an indicator for determining strength since 1880. It is referred as the muscular strength and force that they can generate with their hands. It is the result of forceful flexion of all finger joints, thumbs, and wrists with a maximum voluntary force that the subject is able to exert under normal biokinetic conditions.[6,7] There are 35 muscles involved in the movement of the forearm and hand, with many of these involved in gripping activities. During gripping activities, muscles of the flexor mechanism in hand and forearm create grip strength while the extensors of the forearm stabilize the wrist.[8] According to German Sports Scientist Weinick[9], the characteristic structure of the hand is related to its function as a grasping tool. Grasping ability is made possible by the fact that the thumb can be opposed to the fingers. The fingers and the thumb act as a versatile pair of pliers. They need the palm of the hand as a flat base, on which the object grasped can be held. Extensor digitorum increases the joint compression and enhances the joint stability.

HGS is a physiological variable that is affected by a number of factors including age, gender, body size, weight, height, muscle strength, fatigue, time of the day, age, nutritional status, restricted motion, percentage of body fat, and lean body mass. Strong correlations between HGS various anthropometric traits were reported.[10,11] Correlation of dominant (DM) and non-DM (NDM) HGS and percentage of lean body mass in cricket and football players were studied. This study offers the opportunity to enhance, update and clarify the understanding of the relationships between isometric HGS and anthropometric dimensions. So that, we can plan training programs to increase hand grip which will lead to better performance of cricketers and football players.

Normally, a person starts taking part in a game or event without proper guidance. It is, thus, a sheer chance that his choice of the sport may be suitable to his inherent capabilities. Therefore, the failure to become a champion in most of the cases is inevitable. Thus, there is an urgent need to provide counseling to those endowed with such suitable characteristics that form the basis of performance in a game or event. This may be one of the most important factors that can help in raising the standard of sports in most of the countries. In Japan, however, the system of selection keeping physique in view has been adopted in more than 1000 schools and was administered to some three hundred thousand subjects from the kindergartens to the universities. Physical fitness is required in the promotion of National Programme of physical training. However, physique is not the exclusive factor for selection. The other factors which determine performance also need due consideration. With this in view, it is desirable to focus attention of those who are connected with sports in one way or the other for improving selection procedures, particularly in childhood. "Catch them young" should be the aim. The selection of talent in this way will help utilizing the time and energy of the coaches and the athletes in a more effective manner. It will also be useful in improving the methods of training for children and give a new look to the system. The poor performance of Indian athletes and sportsmen at the international competitions has been of great concern, especially to the coaches, physical educationists, and sports scientists. Efforts have been made to improve the standards of our sportsmen since long; however, little success has so far been achieved in this respect.

There is a paucity of literature in comparison of most commonly played sports in India, i.e., football and cricket which can explain anthropometrical difference in them. Furthermore, there are many studies which have been conducted to check the correlation such as bone mineral density, and with HGS. This has been used as a predictive factor for rehabilitation and recovery. Hence, I felt the need to do this study, in which we have compared anthropometric parameters of cricket players and football players. We have planned to find out the correlation of HGS and anthropometric parameters, and we have focused on the effect of dominance on HGS.

MATERIALS AND METHODS

Normal healthy cricket and football players playing cricket from past 3 years still playing at university level, state level or national level with age group between 15 and 25 years who were practicing in daily cricket and football practice for 2-3 h for 6 days a week were included in the study. Subjects suffering from disease or injury or any treatment and surgery that affect upper extremity strength were excluded. Ambidextrous subject using both hands with equal ease were also excluded from the study. This study was approved by the Ethical Committee. Unpaired test was applied for the comparison between cricketers and football players for the variables of percentage of lean body mass.

- + - Suggestive significance $0.05 < P < 0.10$.
- * - Moderately significant $0.01 < P \leq 0.05$.
- ** - Highly significant $P \leq 0.01$.
- Not significant $P > 0.05$.

All the statistical calculations were performed using the software SPSS for Windows (statistical package for social sciences) version 19.0. Pearson correlation coefficient established a correlation of anthropometric parameter with HGS. Pearson correlation coefficient established a correlation of percentage of lean body mass with HGS.

- $r > 0.7$ = Highly positive correlation.
- $0.4 < r < 0.7$ = Moderately positive correlation.
- $0.4 < r$ = Low positive correlation.

The hand grip dynamometry used in the study was of the digital hand grip-3 (Product of SAEHAN Corporation Company, South Korea) (Figure 1a and b). It is type of electronic hand grip dynamometry. Instrument reliability digital handheld dynamometer used for in the study had been proved reliable by Faria in his study.[12] Specifically, about Sehan's HGD, good validity and reliability are stated by Reis 2010.[13]

A standard testing position as approved by American Society of Hand Therapists was used (Innes 1999[14], Mathiowetz 1985[15]). How to use the hand grip dynamometry was demonstrated to all subjects.[14,16-18] Measurements were taken for all subjects around midday, i.e., 11.00-12.30 h, as it is proved to be significantly stronger at these times.[19] Johanson (1983)[20] found a significant difference between the volume of verbal command and isometric contractions, where increased volume resulted in increased strength. Hence, same tone and volume of instructions were given in this study each time a test was conducted. To get the maximum reliability of data collected, every subject was asked to squeeze the dynamometer for 3 times. Mean of these three trials were taken as the readings.[21] Innes[14] recommended a 60 s rest period between trails on isometric tests. It was recommended that a 3 s grip was usually sufficient to register a maximum reading hence 3 s is taken for the length of contraction time in this study.[22]

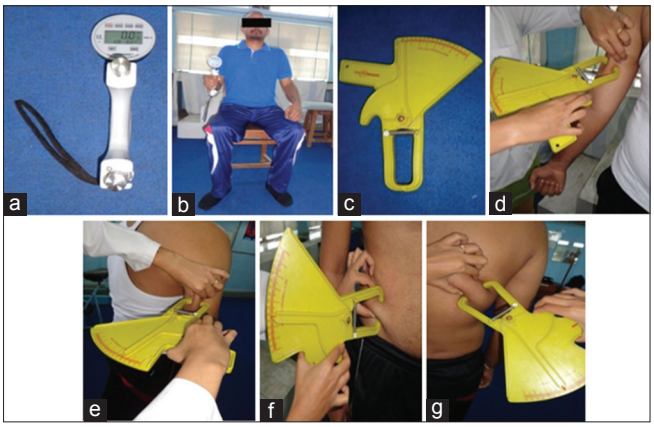


Figure 1: (a) Sahen's hand grip dynamometer (front view); (b) hand grip strength measurement dominant hand (front view); (c) Harpenden's skinfold calliper; (d) biceps skin fold thickness; (e) triceps skin fold thickness; (f) suprailiac skin fold thickness; (g) subscapular skin fold thickness

Percentage of lean body mass calculated by formula = 100 − Percentage of body fat. For percentage of body fat, all measurements were taken along the skin lines over the bare skin. We measured the skin fold thickness at standard sites using skin fold caliper on the right side. This caliper is scientifically developed and calibrated (Figure 1c). The instrument has springs which exert a certain pressure on skin fold which measures the thickness in mm. By measuring at key locations, it is possible to estimate the total percentage of body fat of a person. We grasped the skin and underlying layer of fat with a finger and hold it with the fingers of left hand. A fold of skin and subcutaneous tissue was picked up firmly between the thumb and forefinger 1-2 cm above the marked cross and pulled away from the underlying muscle. The jaws of the caliper were placed on either side of the cross below the fingers at a depth of approximately 1 cm. The surface of the caliper jaws was held parallel to the plane of the skin fold. The skin fold was held firmly throughout the application of the caliper, and the reading was taken once the needle became steady. The skin fold thickness was measured using a validated skin caliper to the nearest 0.2 mm. While holding the caliper in the right-hand place the jaws of caliper should be about one-fourth inch from the finger of left hand, which continues to hold the fold of skin. We measured all 4 locations bicep, triceps, and noted down the readings. Then added four readings and percentage of body fat can then be determined.[23] For bicep skin fold thickness (Figure 1d) midpoint between the acromion process and the lateral condyle of the elbow was marked. The subject was asked to sit, and flex the elbow to 90°, and the measurement was taken at the anterior aspect of the arm at the marked level.[23] For triceps skin fold thickness (Figure 1e), subject was asked to stand with the arm hanging by the sides, and the midpoint between the acromion process and the lateral condyle of the was marked. The measurement was taken on the posterior aspect of the arm over the bulk of the triceps at the level marked.[23] For suprailiac skin fold thickness (Figure 1f) it was located 5 cm above the anterior superior iliac spine. It was measured with a fold descending medially (inwards) and downward at an angle of 45° to the horizontal, i.e., the protrusion of the hip bone a little toward front and parallel to the bone below lifted diagonally, following the natural line of the iliac crest.[23] For subscapular skinfold thickness (Figure 1g) measurement was made just below the inferior angle of the scapula. It was measured in an oblique plane descending laterally (outwards) and downward at an angle 45° to the horizontal, i.e., below the inferior angle of the scapular skinfold parallel to the border was taken, i.e., back, below the shoulder blade.[23] Then add four readings and

percentage of body fat[23] can then be determined from Annexure I and as mentioned above percentage of lean body mass is calculated from 100% of body fat.

RESULTS

Statistically, there is a highly significant difference observed in percentage of lean body mass between football and cricket players ($P < 0.01$) (Table 1). There is positive correlation observed between percentage of lean body mass with DM and NDM HGS in football and cricket players (Table 2).

DISCUSSION

Our study shows that statistically highly significant difference observed in percentage of lean body mass between football and cricket players ($P < 0.01$) and also there is positive correlation observed between percentage of lean body mass with DM and NDM HGS (DM and NDM) in football and cricket players.

There is a paucity of literature for comparison of percentage of lean body mass in football and cricket players. Regarding football game, Australian football players show similar range of percentage lean body mass when compared with percentage of lean body mass of our football player in study conducted by Veale et al. (mean of percentage of LBM 84.72).[24] Indian cricket players show a similar range of percentage lean body mass when compared with percentage of lean body mass of our cricket player in a study conducted by Koley and Yadav (mean of percentage of LBM 85.98) which is more as compared with their control counterpart.[25] From our results, it is observed that there is significantly more percentage lean body mass present in football players than cricket players (Table 1 and Graph 1). It may be due to genetic variation, environmental factor, nutrition, and exercise variation. Seeman et al. in 1996 reported that 80% of the individual variation in lean mass is genetically determined.[26] Lean body mass represents the weight of muscle, bones, ligaments, tendons, and internal organ which is calculated from, percentage of lean body mass =100 − percentage of body fat.[27]

Study conducted by Manna et al., to observe the effect of training on morphological parameters in young Indian football player, shows that in preparatory phase 6 months (PP) and in competitive phase 12 months (CP) leads to improve. Mean of percentage lean body mass before starting exercise was 41.8. It changes to 18% and 14.6% after PP and CP. So proper training programs lead to get improvement.[28] Hence, percentage lean body mass should be maintained within normal range to get success of cricket and football players. So proper and specific training, methodologies, diet plans, nutrition factors, practicing hours should be considered and an appropriate plan of guideline given to the player. The coach should take daily follow-up of all above factors to get better performance. Our results also show that DM and NDM HGS continued to be increased with increase in percentage of lean body mass in both cricketers and football players. For DM hands, in cricketers $r = 0.16$ in football players $r = 0.03$, (Table 2). For NDM hands, in cricketers $r = 0.27$, in football players $r = 0.05$, (Table 2). Similar result with our finding, i.e., HGS is positively correlated with is percenatge of lean body mass is shown by Fallahi and Jadidian ($r = 0.536$).[29] Dissimilar result with our finding, i.e., HGS is negatively correlated with is percentage of lean body mass is shown by author Koley and Yadav (for right-hand $r = -0.400$ and for light hand $r = -0.372$).[25] More lean body mass will lead to more muscle area. Hence, more lean mass present in hands also.

Table 1: Comparison of percentage of lean body mass between football and cricket players

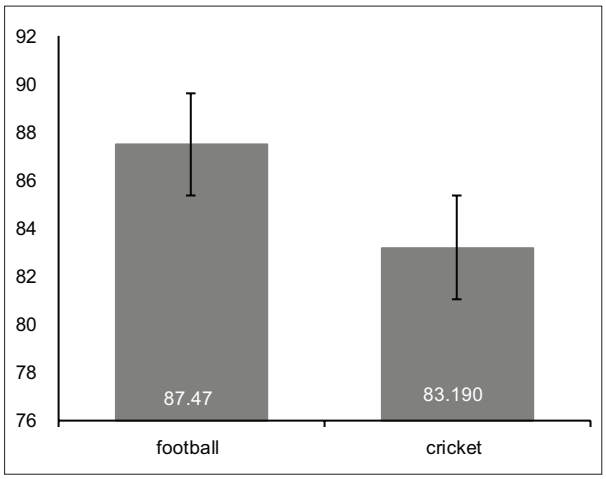
Percentage of lean body mass	Football players	Cricket players
N	30	30
Mean	87.47	83.19
SD	4.55	3.88
t-test	3.85 ($P<0.01$)	

SD: Standard deviation

Table 2: Correlation between percentage of lean body mass with hand grip strength in football and cricket players

Parameter	Football players (N=30)		Cricket players (N=30)	
	DM	NDM	DM	NDM
Correlation coefficient (r)	0.03	0.05	0.16	0.27

DM: Dominant, NDM: Nondominant



Graph 1: Comparison of % Of lean body mass between Football and Cricket players.
Statistically there is highly significant difference observed in % of Lean body mass between Football & cricket players ($p<0.01$).

As per, Klausen[30] the maximal force or tension produced by a muscle depends on the cross-sectional area of all the muscle fibers within the muscle the physiological cross-sectional area. A number of muscle fiber, length of muscle fiber is more when muscle mass is more. Thus, a muscle with a large cross-sectional area is able to produce greater maximal force than a muscle with a small cross-sectional area.[30] This may lead to a positive correlation of percentage of lean body mass and HGS. Hence, percentage of lean body mass should be maintained within the normal range to get proper HGS. Better HGS lead to better performance of cricket and football players. So proper and specific training, methodologies, diet plans, nutrition factors, practicing hours should be considered and an appropriate plan of guideline given to the player. The coach should take daily follow-up of all above factors to get better performance.

Hence, there is need to improve physical fitness parameter to enhance a players performance. Weight and height training should be implemented at junior level to build whole body mass and to counter asymmetric load placed on the body through the nature of game. HGS has relatively high heritability, and the importance of genetic factor seems to be of equal size. We can use this phenotypic information when looking for genes important for physical function in second half of life. HGS training programs should be planned. Talent identification programs, Scientific Training Programmes, should be held at a various level such as school, college, university, and state. All anthropometric parameters should be assessed by coach periodically. He should consider all factors affecting it, i.e., nutrition, motivation, practicing hours, economical condition, and type of exercise. He should give a proper guideline to player and arrange proper training programs.

All anthropometric parameters like percentage of lean body mass, HGS should be assessed by coach periodically.

There is need to improve physical fitness parameter to enhance a players performance. Body fat training and HGS training should be implemented at junior level to build whole body mass and to counter asymmetric load placed on the body through the nature of game. HGS training programs should be planned at a various level such as school, college, university, and state. Through this, we can give a specific sports prescription to the player while selecting a sport. In Japan, they have already implemented this sports prescription method at earlier stages which help a person to choose a game. So it should be considered in India as it will be helpful for the performance of the player our purpose of "right sport for right person" should be served.

CONCLUSION

Proper training for maintaining percentage of lean body mass and HGS will increase in HGS. It will further lead to better strength and performance in cricket and football activities.

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