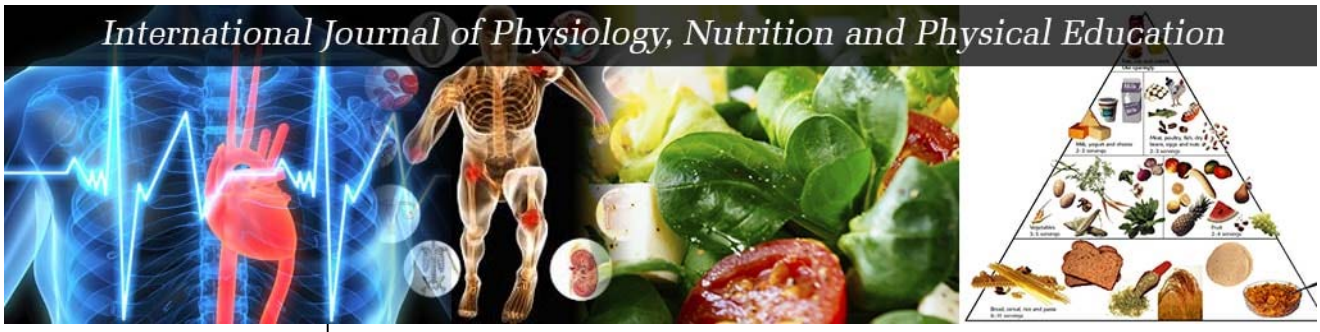

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Correlation of corrected mid upper arm muscle area, mid upper arm fat area, tricep skin fold thickness with hand grip strength in cricket players: A Cross-sectional study

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Abstract
Background: Hand grip strength and corrected mid upper arm muscle area, mid upper arm fat area, tricep skin fold thickness has been an indicator for determining strength.
Objectives: The purpose of study was to found out for correlation of corrected mid upper arm muscle area, mid upper arm fat area, tricep skin fold thickness with hand grip strength in cricket players.
Material and Methods : Total 30 healthy cricket (15-25 years), from district sport academy, regularly practicing from last 3 years at university level and who don't have any abnormality of upper arm or any neurological problem, history of fracture of hand were included. Measurement of hand grip strength with help of Sahens hand grip digital dynamometer was done. Mean of three reading was taken as final reading. Corrected Mid upper arm muscle area calculated by standard formula, [{Mid upper arm circumference- (π x TSF/10)} ^{2}-10] /4π. Mid Upper Arm Circumference measured by measuring tape. Tricep skin fold thickness is measured by harpendence calliper. Mid upper arm fat area calculated by standard formula, [Mid upper arm area- mid upper arm muscle area] Pearson correlation coefficient established a correlation of corrected mid upper arm muscle area, tricep skin fold thickness with hand grip strength.
Result: It was found that, statistically there was highly significant positive correlation observed between hand grip strength with corrected mid upper arm muscle area. It was also found that, there was positive correlation observed between hand grip strength with mid upper arm fat area and highly significant negative correlation between hand grip strength with tricep skin fold thickness in cricket players**.**
Conclusion: Proper training for maintaining mid upper arm muscle area, mid upper arm fat area, tricep skin fold thickness and hand grip strength will increase in hand grip strength. It will further lead to better strength and performance in cricket activities like bowling, fielding etc.

Keywords: Anthropometry, Dynamometry, Handgrip strength, Harpendence calliper, Corrected mid upper arm muscle area, Mid upper arm fat area, Mid upper arm circumference, Mid upper arm area, Tricep skin fold thickness

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. Amongst sports, cricket is more popular as it is a 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 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 corrected mid upper arm muscle area, mid upper arm fat area, tricep skin fold thickness and hand grip strength play an important role in cricket. Many scientist have done a research on anthropometric parameters of cricket players and hand grip strength in them [4, 5].

Contemporary sport 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 programmes for improvement of these parameters.

Hand grip strength 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, wrists with maximum voluntary force that the subject is able to exert under normal bio kinetic conditions [6, 7]. There are 35 muscles involved in movement of the forearm and hand, with many of these involved in gripping activities. During gripping activities, muscles of the flexor mechanism in the hand and forearm create grip strength while the extensors of the forearm stabilize the wrist [8]. According to German Sports Scientist Weinick J [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.

Hand grip strength 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 & lean body mass. Strong correlations between hand grip strength various anthropometric traits were reported [10, 11]. Correlation of dominant and non-dominant hand grip strength and corrected mid upper arm muscle area, mid upper arm fat area, tricep skin fold thickness in cricket players were studied. This study offers the opportunity to enhance, update and clarify the understanding of the relationships between isometric hand grip strength and anthropometric dimensions. If simple techniques like measurement of corrected mid upper arm muscle area, mid upper arm fat area, tricep skin fold thickness, mid upper arm circumference, tricep skin fold thickness will help in guiding about hand grip strength, it will become very easier for coach to direct the player. So that, we can plan training programmes to increase hand grip which will lead to better performance of cricketers 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 counselling 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 one thousand 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 sport 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 paucity of literature in India, to check the correlation of anthropometric parameters, with HGS (hand grip strength). Hence, I felt the need to do this study, in which we have found out correlation of hand grip strength and anthropometric parameters.

Material and methods

Normal 30 healthy cricket players playing cricket from last 3 years still playing at university level, state level or national level with age group between 15- 25 years who were practicing in daily cricket practice for 2-3 hours 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 study. The present study was approved by the Ethical Committee.

- + 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 parameters like mid upper arm circumference, mid upper arm area, tricep kin fold thickness with hand grip strength.

$r > 0.7$ = highly positive correlation.

$0.4 < r < 0.7$ = moderately positive correlation.

$0.4 < r$ = low positive correlation.

The hand grip dynamometry used in study was of the Digital Hand Grip (DHD-3). (Product of SAEHAN Corporation Company, South Korea). (Fig a,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 is stated by Reis 2010 [13].

A standard testing position as approved by American Society of Hand Therapist (ASHT) was used (Innes 1999, Mathiowetz 1985) [14, 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 hours to 12.30 hours, as it is proved to be significantly stronger at these times.[19] Johanson[20] (1983) 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 three times. Mean of these three trials were taken as the readings [21]. Innes [14] recommended a 60 seconds rest period between trails on isometric tests. It was recommended that a 3 seconds grip was usually sufficient to register a maximum reading hence 3 seconds is taken for length of contraction time in this study.[22]

Corrected Mid upper arm muscle area calculated by standard formula [23-26], [{Mid upper arm circumference- (π x TSF/10)}^{2}-10] /4π. Mid Upper Arm Circumference (Fig. c,d) is measured by measuring tape. The arm was relaxed and hanging by the side, and the circumference taken at the level of the mid-point between the acromion (bony point of shoulder) and the olecranon (bony point of elbow). Conventionally maximum muscle girth is maximally present at 5 inches above and 4 inches below elbow joint and 9 inches above and 6 inches below knee joint in lower limbs. When recording, tape haven't kept too tight or too loose, is lying flat on the skin, and was horizontal. Reading with 1mm accuracy was noted. We measured the tricep skin fold thickness at standard sites using skin fold calliper on the right side. This harpendence calliper is scientifically developed and calibrated. The instrument has springs which exert a certain pressure on skin fold which measure the thickness in mm. We grasped the skin and underlying layer of fat with finger and holded 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 calliper were placed on either side of the cross below the fingers at a depth of approximately 1 cm. The surface of the calliper jaws were held parallel to the plane of the skin fold. The skin fold was held firmly throughout the application of the calliper and the reading was taken once the needle became steady. The skin fold thickness was measured using a validated skin calliper to the nearest 0.2 mm. While holding the calliper in the right hand place the jaws of calliper should be about one fourth inch from the finger of left hand, which continues to hold the fold of skin. For Tricep Skin fold Thickness (Fig. e, f) 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 [27].

Mid upper arm fat area calculated by standard formula [25], [Mid upper arm area- mid upper arm muscle area]. Mid Upper Arm Area [23, 24, 28] is calculated by formula, (Mid upper arm circumference)^2 /4π= (MUAC)^2 /12.57. Mid upper arm muscle area is calculated by [25], [Mid upper arm muscle circumference ^{2}/4π. Mid upper arm muscle circumference is calculated by formula [25], [mid upper arm circumference – (π x TSF/10)]

FIGURES

Fig. a : Sahen's HGD Front View

Fig. b : HGS Measurement DM Hand (Front View)

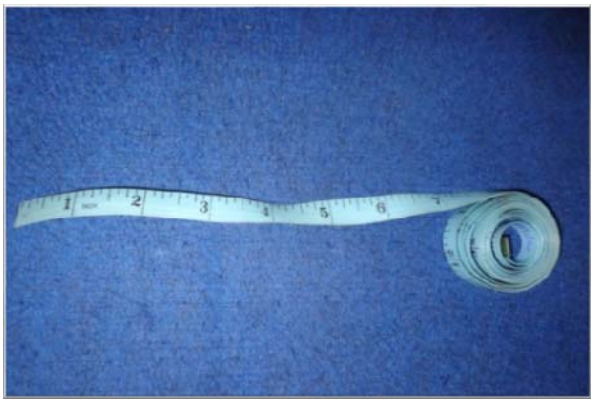

Fig. c: Measuring Tape

Fig. d: MUAC Measurement

Fig. e : Harpendens Skinfold Caliper

Fig. f : Ts Measurement

RESULT

- There is highly significant positive correlation observed between Corrected mid upper arm muscle area with dominant and non dominant handgrip strength in Cricket players ($P < 0.01$).
- There is low positive correlation observed between Mid upper arm fat area with dominant and non dominant handgrip strength in cricket players.
- There is low negative correlation observed between Ts and dominant handgrip strength in Cricket players and there is highly significant negative correlation observed between Ts and non dominant handgrip strength in Cricket players ($P < 0.01$).

Table 1: Correlation of Hand grip strength & corrected mid upper arm muscle area, mid upper arm fat area, and tricep skin fold thickness in Cricket players

	CMUAMC		MUAFA		Ts	
	DM	NDM	DM	NDM	DM	NDM
Correlation coefficient (r)	0.56	0.56	0.01	0.05	-0.31	-0.37
t test	3.61	3.60	0.07	0.28	-1.73	-2.09
P value	P < 0.01	P < 0.01	P> 0.05	P> 0.05	P>0.05	P<0.01

DM: Dominant hand, NDM: Non dominant hand

Discussion

Our results shows that dominant and non dominant hand grip strength (DM and NDM HGS) continued to be increased with increase in corrected mid upper arm muscle area (CMUAMA) in cricketers For dominant hands, in cricketers r=0.56,t=3.61,(table1). For non dominant hands, in cricketers r=0.56,t=3.60,(table1).More CMUAMA will lead to more MUAA. As it is one of the part of upper arm area.

Similar result with our finding i.e.arm muscle area is positively correlated with hand grip strength in Indian cricket players is shown by other authors like Koley S (2009, for rt hand r= 0.506 and for lt hand r=0.539) [29], PieterseS (2002) [30]. As per, Klausen K (1990) 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. 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.[31]This reason may lead to positive co-relation of CMUAMA and hand grip strength in our cricket player. More CMUAMA values can be achieved by proper healthy diet, regular and planned exercise, appropriate type and duration of exercise. Proper training of players should held under observation of coach. Follow up and changes as per requirement of player's physique should be done time to time.

Our results also shows that dominant and non dominant hand grip strength (DM and NDM HGS) continued to be increased with increase in corrected mid upper arm fat area (MUAFA) in cricketers. For DM hands, in cricketers r=0.01, t=0.07 (table 1). For NDM hands, in cricketers r=0.05, t=0.28, (table 1).

Similar result with our finding i.e. arm fat area is positively correlated with HGS in Indian cricket players is shown by KoleyS (2009, for rt hand r= 0.326 and for lt hand r= 0.292) [32] There must be some amount of fat which is required for many activities in sport. Excess of this fat is not favorable. But within normal limit, this essential fat is helpful for exerting force on dynamometer which will lead to get better hand grip strength. So proper amount of mid upper arm fat area gives good results favoring hand grip strength. Also, Mid upper arm fat area calculated by standard formula [25], [Mid upper arm area- mid upper arm muscle area]. Mid Upper Arm Area [23, 24, 28] is calculated by formula, (Mid upper arm circumference)^2 /4π= (MUAC)^2 /12.57. Mid upper arm muscle area is calculated by [12, 3], [Mid upper arm muscle circumference ^{2}/4π. Mid upper arm muscle circumference is calculated by formula [25], [mid upper arm circumference –(π x TSF/10)] Mid upper arm muscle area (MUAMA) and mid upper arm area (MUAA) are again dependent on tricep skin fold thickness, mid upper arm circumference. In our results, MUAFA and MUAA are positively correlated with hand grip strength. These may be the reasons for positive correlation of hand grip strength and mid upper arm fat area (MUAFA).MUAFA should be maintained within normal range to get proper hand grip strength. Better grip strength lead to better performance of cricket and football players. So proper and specific training, different methodologies, diet plans, nutrition factors, practicing hours should be considered and a appropriate plan of guideline given to the player to maintain body fat percentage. The coach should take daily follow up of all above factors to get better performance.

Our results shows that dominant and non dominant hand grip strength (DM and NDM HGS) continued to be decreased with increase in tricep skin fold thickness in cricketers. For DM hands, in cricketers r= -0.31, t=-1.73, For NDM hands, in cricketers r=-0.37, t=-0.29, (table 1).

Dissimilar result with our finding i.e. tricep skin fold thickness is positively correlated with hand grip strength in Indian cricket players, is observed by other author like KoleyS (2009, for rt hand r= 0.278 and for lt hand r= 0.210)

[29]. Particular amount of fat (essential fat) is required for sportsman to do various activities in sport. But excess amount of this fat will lead to an unfavorable condition. If this excess fat cover much area of muscle mass then less space remained for muscle tissue in that area. So less muscle tissue lead to less muscle fiber which lead to less force exertion on hand grip dynamometer which cause low reading of hand grip strength. This may be reason for negative correlation of hand grip strength and tricep skin fold thickness. Tricep skin fold thickness should be maintain within normal range to get proper hand grip strength. Better hand grip strength lead to better performance of cricket players. So proper and specific training, different methodologies, diet plans, nutrition factors, practicing hours, specific exercises of upper arm should be considered and a appropriate plan of guideline given to the player to maintain tricep skin fold thickness. The coach should take daily follow up of all above factors to get better performance.

Conclusion

There is need to improve physical fitness parameter to enhance players performance. Hand grip strength has relatively high heritability and 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. Hand grip strength training programmes should be planned. Talent identification programmes, scientific training programmes should be held at various level such as school, college, university, state. Coach should consider all factors affecting it i.e. nutrition, motivation, practicing hours, economical condition, type of exercise. He should give proper guideline to player and arrange proper training programmes. All anthropometric parameters like mid upper arm circumference, mid upper arm muscle area, mid upper arm fat area, tricep skin fold thickness, hand grip strength should be assessed by coach periodically.

There is need to improve physical fitness parameter to enhance players performance. Body fat, muscle mass training and hand grip strength 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. Hand grip strength training programmes should be planned at various level such as school, college, university, state. Through this we can give a specific sport prescription to player while selecting a sport. In Japan, they have already implemented this sport prescription method at earlier stages which help 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.

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