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Relationship of physiological parameters with the fielding skill among the male softball players

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Abstract
The purpose of this study was to ascertain relationship of physiological parameters with fielding skill among softball players. Total 150 male softball players from the various states and universities of India were selected to participate in the study. Vital capacity of the subjects was measured with the help of the computerized spirometer. Cooper's 12 minutes run/walk test was used to assess the aerobic fitness (VO_{2max}) of the subjects. Speed was measured with the 50m dash. Explosive strength of the subjects was determined by using the standing vertical jump. Sit and reach test was used to measure the flexibility of the subjects. Grip strength was determined with the help of hand dynamometer. Softball playing ability of the players was assessed by AAHPERD softball skill test battery. The results revealed that the physiological parameters i.e. aerobic fitness (VO_{2max}), explosive strength, speed, flexibility and grip strength of both right and left hand demonstrated a significant correlation with the fielding skill among the softball players.

Keywords: physiology, performance, fielding, aerobic fitness, softball

1. Introduction
Physiological capacity of players is an indispensable element of success in sports achievements. It involves large number of parameters including strength, speed, flexibility, aerobic capacity, vital capacity etc. Performance in sports is a multivariate phenomenon; it may be influenced by physique in addition to physiological function, biochemical constraints, psychological state, environment and socio-cultural factors. [1] The physiological measurements in sports provide opportunities to learn more about the responses of individuals to the demands of exercise and the physiological adaptations to training which underlie improvements in human performance. Softball is one of the fast games which necessitate multi-directional quickness, first step quickness, lateral movements, acceleration and linear speed for best performance [2]. Softball is a physically demanding sport comprised of several specializations such as hitting, fielding, throwing, pitching, base running etc. requiring diverse skills and different types of fitness. It involves pitching, hitting, throwing, base running, jumps off the bases and other movements are explosive in nature and require speed and strength [2]. It requires upper extremity power, hand grip strength, excellent eye-to-hand coordination and the coordinated movements of the hips, shoulders, arms and wrists. It requires speed, strength and endurance [3]. Dynamic flexibility is also one of the important aspect of softball which influences the ability to move through a full range of motion and contributes to improved performance [2]. Due to the intermittent, repetitive and high intensity of the games in team sports, it is often supposed that high aerobic power i.e. maximal oxygen uptake or consumption (VO2max) plays an important role in enhancing the performance. VO_2max is an important physiological parameter that is associated toremarkable health, wellbeing, life quality, work ability, and performance [4, 5, 6, 7, 8]. It generally refers to the maximal capacity of an individual to perform aerobic work and is the product of cardiac output and arteriovenous oxygen difference at exhaustion [6]. Vital capacity, a surrogate measure of respiratory muscle strength is the largest volume of air that can be exhaled followed by deepest possible inhalation [9]. Respiratory system can impact the strength and exercise performance in healthy humans and the highly trained players [10, 11, 12]. Grip strength is an important attribute and standard parameter associated to the functional integrity of the hand. It is essential to produce adequate grip strength to manage daily activities. Grip strength determines the handedness of a person. The measurement of grip strength is simple and convenient way to assess forearm and hand function [13]. Grip strength is also used as a marker of the overall physical strength [14]. Keep these aspects in mind, it was planned to study the association of physiological parameters with the fielding skill among the male softball players.

2. Methodology
The subjects of the present study were purposively selected from the university level and national level male softball players. 150 male softball players of different universities and states of India were selected to participate in the study. The average age of the softball players was 20.89±1.54 years. The average height and weight of the softball players were 173.49±6.12 cm 65.62±8.35 kg respectively. All the players were assessed for following physiological parameters along with the tests used to measure the physiological parameters.

Table 1: Tools and measurement units of physiological variables

Sr. No	Component	Tests	Unit of Measurement
1	Vital Capacity	Computerised spirometer	Liters
2	Aerobic Fitness (VO_{2max})	Cooper's 12 minutes run/ walk test	ml/kg/min
3	Speed	50m dash	Seconds
4	Explosive Strength	Standing vertical jump	Centimeters
5	Flexibility	Sit and reach test	Centimeters
6	Grip Strength	Hand dynamometer	Kilograms

Fielding Test

Throwing skill of the players was assessed as given in the AAHPERD softball skill test battery edited by Dr. Roberta Rikli [15]. This test item assesses the fielding ground ball ability of the subject. Validity coefficient of correlation has been found to range from 0.60 to 0.85. Reliability coefficient of correlation ranged from 0.69 to 0.91 from the intra-class test-retest scores. For this test the area was marked as shown in fig. The subject stood behind the restraining line (Point A). A thrower (Point B) stood behind the throwing line and throws six test balls to each subject. Each throw must strike the ground before the 30-feet line and must stay within the sideline boundaries of the marked area. The throws were sidearm, with sufficient velocity to carry an untouched ball beyond the end line (Point C). Of the six test trials, two balls (in varying order) were thrown directly to the subject, two to the right and two to the left side of the subject. Each ball cleanly fielded in front of the 60-feet line was count 4 points. A ball counted 2 points when it was stopped, but bubbled. Balls fielded behind the 60-foot line received one-half the points normally earned. Balls that get past the subject scored no points. The final score was the sum of six trials.

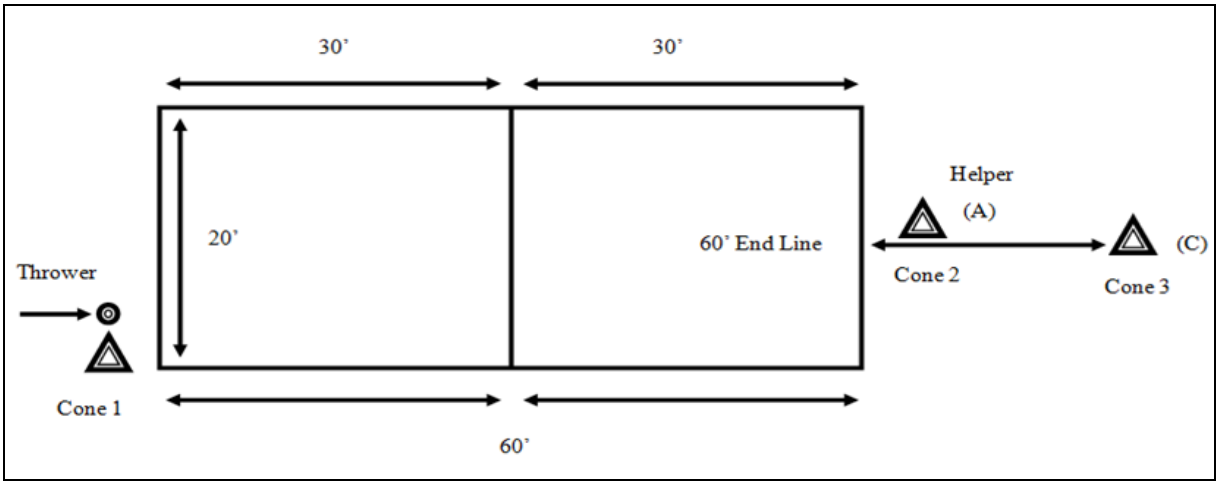

Fig 1: Field marking for fielding ground balls test

Statistical Analysis

Statistical analysis was performed using SPSS version 16.0 for windows (SPSS Inc, Chicago, IL, USA). Karl Pearson's product moment co-efficient of correlation was computed to assess the relationship between physiological parameters and throwing skill test of softball among the softball players. Significance levels were set at $p<0.05$.

Results

Table 2: Relationship of various physiological parameters with the fielding skill test in male softball players

Variables	N	Pearson Correlation Coefficient (r)	Sig. (2-tailed)
Vital Capacity (L)	150	0.001	0.987
VO_{2max} ($ml.kg^{-1}.min^{-1}$)	150	0.248	0.002*
Speed (sec)	150	-0.238	0.003*
Explosive Strength (cm)	150	0.383	0.000*
Flexibility (cm)	150	0.220	0.007*
Grip Strength of Left Hand (kg)	150	0.172	0.032*
Grip Strength of Right Hand (kg)	150	0.265	0.001*

* Indicates $p<0.05$

Table 2 presents the relationship between the fielding skill test and various physiological parameters of the male softball players. The statistical results showed that the vital capacity did not show significant correlation with the fielding skill test in the male softball players. The aerobic fitness (VO_{2max}) demonstrated a significant correlation ($r = 0.248$, $p=0.002$)

with the fielding skill amongst the male softball players. The speed was also found to have a significant association (r = -0.238, p=0.003) with the fielding skill test among the male softball players. The explosive strength of the male softball players (r = 0.383, p=0.000) showed a significant correlation with the fielding skill test. The flexibility also demonstrated a significant correlation (r = 0.220, p=0.007) with fielding skill test of the male softball players. The grip strength of both right (r = 0.265, p=0.001) and left hand (r = 0.172, p=0.032) also showed a significant relationship with fielding skill test among the male softball players.

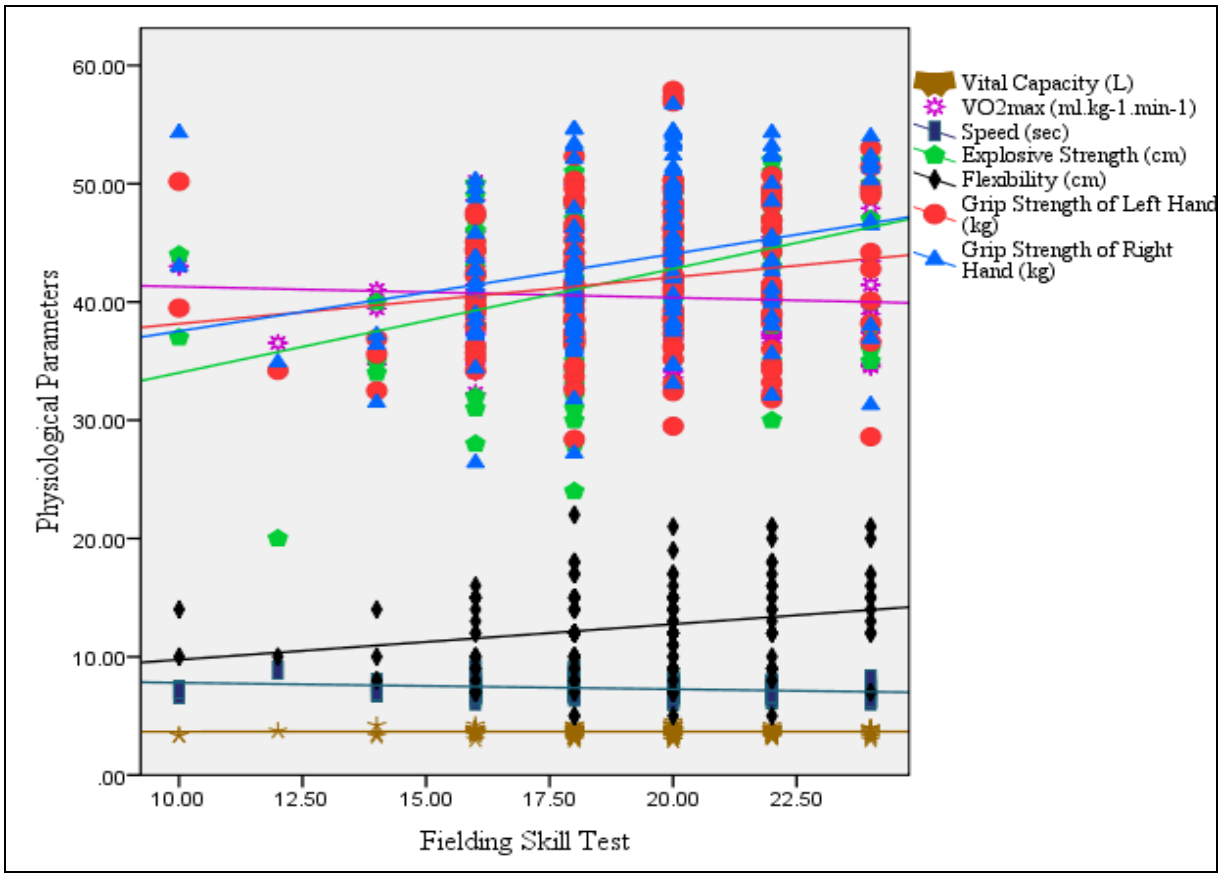

Fig 2: Scatter plot for association of physiological parameters with fielding skill test in male softball players

Discussion

The understanding of physiological aspects of elite level players in a given sport may be beneficial for optimizing training programs specific to the requirements of that particular sport and achieving higher performance level. Physiological parameters such as explosive strength, grip strength, speed and flexibility were significantly associated with fielding skill among male softball players. These results are in agreement with those reported by Mangine *et al.* [16] on professional baseball players in which a relationship between fielding performance and vertical jump height and pro-agility was confirmed and vertical jump height was the single best predictor of fielding performance for all players and proagility was best predictor of fielding performance among outfielders. Kohmura *et al.* [17] studied the Japanese college baseball players and reported a significant relationship between physical fitness and coaches' evaluation of performance. Research in the physiological profiles of softball players confirms that muscular fitness has high degree of importance for fielding performance in softball [3, 18, 19, 20]. Coleman [21] studied the average time and speed of major league baseball players and reported the importance of speed in fielding balls in the gaps, backing up bases, getting in position for cut-off and relay plays. Ellis [18] also reported that speed is obviously critical for agility in fielding. The flexibility measured through sit and reach test showed a significant relationship with fielding skill. Ellis [18] observes that flexibility becomes a physical requirement in softball for bending and reaching to field ground balls. VO_{2max} was associated with batting skill only in male softball players. However, it is reported in literature that the low-medium level of aerobic capacity is required in fielding as it does not play a major role in the energy requirements of softball and most of the energy provided through the anaerobic energy system [18, 21].

Conclusions

Physiological parameters play an important role in the performance of sportspersons. In the present study, physiological parameters were significantly associated with the fielding skill of the softball players.

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