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Relationship of physiological parameters with performance among softball players

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Abstract
The aim of this study was to ascertain relationship of physiological parameters with playing ability 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 ($p<0.05$), speed ($p<0.05$), flexibility ($p<0.05$) and grip strength of both right ($p<0.05$) and left ($p<0.05$) hand demonstrated a significant correlation with the softball playing ability.

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

Introduction

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 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 [1]. Softball players need a considerable amount of upper body muscle balance because of the specificity of underarm pitching and overhead throwing activities. Coaches and athletes consider that the forearm plays an important part in hitting, pitching and throwing the ball [2, 3]. Pedegana *et al*. [4]. reported that enhancement in upper-extremity strength (particularly in elbow and wrist extensors) may improve throwing velocity of the baseball players, whereas Spaniol [5]. has indicated that leg power is significantly associated to bat speed, throwing speed, and batted ball velocity among the baseball players. Kohmura *et al*. [6]. Reported that strength, power, and agility were found to have significant relationship with the subjective evaluation of performance in Japanese college baseball players. In another study on minor and major league baseball players, Hoffman *et al*. [7] reported that lean body mass, lower body power, speed and grip strength were significantly related to baseball-specific performance variables of total bases, stolen bases, slugging percentage and home runs.

The development of statistical models to predict performance in softball from laboratory or field tests may be of practical significance in the identification of potentially talented softball players. Performance prediction models have been successfully developed in team sports such as basketball [8] and soccer [9] using both anthropometric and physical performance variables such as body mass, running speed and leg power measures. Various anthropometric, physiological and performance variables have been employed in various studies to contour the prediction formulas. The best possible combination of these variables giving the best prediction result was demonstrated with statistical details. The present study aimed at evaluating the physiological parameters of the softball players from India. It also aimed to ascertain relationship of physiological parameters with playing ability among softball players.

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 data for the study was collected during the 33rd Senior National Softball Championship held at Anantpur District of Andhra Pradesh from 18th to 23rd January, 2012 and All India Inter University Softball Championship held at Panjab University, Chandigarh in February 2012. 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

S. 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

Softball Playing Ability: Softball playing ability of the players was assessed by AAHPERD softball skill test battery edited by Dr. Roberta Rikli. [10] This test battery was based on the measurement of skills essential for softball performance namely batting, fielding, throwing and base running. Accordingly, this test has following four items

1 Batting Test
2 Fielding Ground Balls Test
3 Throwing Test
4 Base Running Test

Statistical analyses

Statistical analyses were 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 playing ability among the softball players. Significance levels were set at $p<0.05$.

Results

Table 2 and fig. 1 presents the correlation coefficient between the softball playing ability and various physiological parameters of the softball players. The statistical results showed that the vital capacity did not show significant correlation with the softball playing ability in the male softball players. The aerobic fitness (VO_{2max}) demonstrated a significant correlation ($r = -0.329$, $p<0.05$) with the playing ability amongst the softball players. The speed showed a significant association ($r = -0.441$, $p<0.05$) with the softball playing ability. The explosive strength of the softball players ($r = 0.504$, $p<0.05$) showed a significant correlation with the softball playing ability. The flexibility demonstrated a significant correlation ($r = 0.346$, $p<0.05$) with softball playing ability. The grip strength of both right ($r = 0.487$, $p<0.05$) and left hand ($r = 0.395$, $p<0.05$) also showed a significant relationship with playing ability of the male softball players.

Table 2: Correlations between various physiological parameters and the softball playing ability of the softball players.

Variables	N	Pearson's Correlation Coefficient (r)	Sig. (2-tailed)
Vital Capacity (L)	150	0.018	0.828
VO_2max ($ml.kg^{-1}.min^{-1}$)	150	0.329	0.000*
Speed (sec)	150	-0.441	0.000*
Explosive Strength (cm)	150	0.504	0.000*
Flexibility (cm)	150	0.346	0.000*
Grip Strength of Left Hand (kg)	150	0.395	0.000*
Grip Strength of Right Hand (kg)	150	0.487	0.000*

* Indicates $p<0.05$

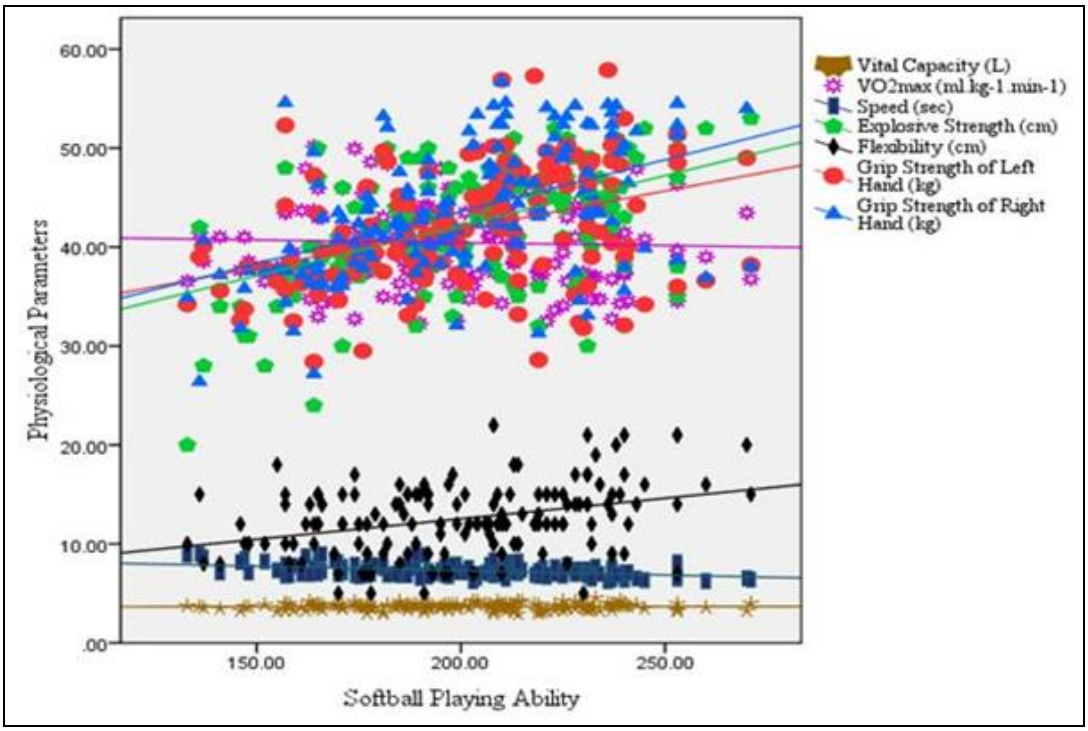

Fig 1: Scatter plot for association of physiological parameters with playing ability in male softball players

Discussion

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. These parameters of softball players in the present study were assessed and associations with performance in softball were evaluated. The explosive strength, grip strength, speed and flexibility were significantly associated with the playing ability among softball players. These findings are in line with many other studies on high school, college level and professional baseball players, [6, 7, 11, 12] youth baseball players [13] and collegiate female softball players. [14, 15] The strength (explosive strength, grip strength etc.) plays an important role in higher performance among softball players. Research in the physiological profiles of softball players confirms the medium-high requirement of strength in hitting, fielding, and pitching and medium requirement in base running. [1, 16] Coleman [17] studied the speed among major league baseball players and reported the importance of speed during offensive play include running out base hits, going base to base, stealing bases, hit and run attempts, and run downs. The role of speed during defensive play include making routine plays, fielding balls in the gaps, backing up bases, relay plays, covering bases and run down situations. The flexibility measured through sit and reach test showed a significant relationship with playing ability among softball players in the current study. A medium amount of flexibility is required in softball for hitting, fielding, base running and high amount of flexibility in pitching. Ellis [16] reported that flexibility becomes a physical prerequisite in softball for bending and reaching to field ground balls during fielding. The VO_{2max} is the indices of the endurance ability among the softball players. A low-medium importance of endurance in hitting, fielding, and base running and low importance of endurance in pitching was reported in physiological profiles of softball players. Ellis [16] reported that endurance does not play a major role in the energy requirements of softball. Szymanski [18] also reported that the only 5% of the energy used in softball comes from the aerobic system, making endurance of little importance. Coleman [17] also affirmed the low-medium importance of endurance in softball. However, endurance aids softball players in base running and fielding requiring a greater number of short intense sprints during long innings.

Conclusion

The present findings thus show that the physiological parameters were significantly associated to softball playing ability among the softball players.

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