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Physiological profiles of Bengalee elite soccer players

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Abstract
The physiological profiles of elite soccer players from Europe, South and North America are easily available from different sources. But there is a scarcity of descriptive data on the physical characteristics of south Asian soccer players especially for Indian. Therefore, the purpose of this study was to identify the physiological characteristics of elite soccer players of West Bengal in India. There were twenty two professional soccer players were selected as subjects for this study. The height, weight, body fat percent, forced vital capacity, maximum oxygen uptake capacity, anaerobic threshold, alactic power index, lactic work index of the Bengalee soccer players were measured. The study observed that physique of Bengalee soccer players appeared to be smaller, lighter and physiological performance capacity trend lowered than those found in worldwide which may be one of the key factors that contribute to the lack of success of Indian soccer team in international competitions.

Keywords: Soccer players, oxygen uptake capacity, body composition, anaerobic power

Introduction
The large number of soccer players in India, research dealing with the performance capacity is lacking. Most physiological data on elite soccer players originate from mid East Asia, Europe and America. To the best of the authors' knowledge, there have been very few comprehensive reports on the physiological characteristics of Indian soccer players. A comparison of such data with those of international soccer players and teams may lighten the factors contributing to the lack of success of Bengalee soccer players in international competitions. Since this is the first study describing the physiological profiles of Bengalee players, it provides baseline data against which future studies can be compared.

Method
There were twenty two top Bengalee professional soccer players of ethnic West Bengal origin volunteered to participate in the present study. The subjects were selected from eight premier division clubs from Kolkata football league. The test battery included measures of body composition, pulmonary function, maximal aerobic power, anaerobic threshold and anaerobic power. All tests except of field tests took place at the Laboratory. Percentage body fat was estimated from skin fold measurement by using skin fold caliper at three different sites on the body surface. The vitalograph spirometer was used to evaluate pulmonary functions for calculating the forced vital capacity (FVC), forced expired volume in one second (FEV1.0) and maximal voluntary ventilation (MVV). Maximal oxygen uptake (VO_{2max}) was measured using a continuous running test performed on a motorized treadmill. All subjects were familiarized with the testing procedures before data was collected. After a 10-min warm-up metabolic and respiratory measurements were computed by displayed monitor energy expenditure unit which included V_E, Vo_2, Vco_2, RQ, $FEco_2$ and FEo_2.Anaerobic threshold (AT) measurements were determined by observing the onset of the non-linear relationship between Vo_2 and V_E,V_{C02} were expressed relative to oxygen consumption (% V_{O2max}) and heart rate (% HR_{max}). Anaerobic power was measured according to the procedure developed to accompany the front access cycle ergo meter and work monitor unit. The field evaluation for an endurance run, the Cooper 12-min run and walk test for distance and sit-and-reach test for flexibility were conducted. The endurance run was conducted outdoors on a turf-surfaced in 200m track. The sit-and-reach test was conducted to measure lower back and hamstring flexibility.

The physiological data of the Bengalee players was compared with that of top soccer players and teams from other countries. Direct statistical comparisons could not be performed since raw data were not available.

Results and Discussion

Anthropometry

Table 1: Physical characteristics of Bengalee elite soccer players

Variables	Mean (S. d.)	Range
Age(years)	26.4(±4.3)	19-31
Height(m)	1.73(±3.7)	1.69-1.76
Weight(kg)	65.2(±5.9)	60.2-71.4
Lean body weight(kg)	60.4(±4.6)	55.1-68.5
Fat % (kg)	7.1(±3.2)	5.7-11.6

The physical characteristics of the subjects were presented in Table 1. As a group, the mean age of players was 26.4 years. Height 1.73 m and weight 65.2kg tended to lower compared with first division English league soccer players 180.4 cm, 76.7kg and Italian professional soccer players 177.2 cm; 74.4 kg. Body size represents ethnic, racial and possibly nutritional influences. Generally, the percentage of body fat of soccer players in his mid-20s is 10-13% of body weight. The subjects in this study were lean, with a percentage of body fat of 7.1kg which appeared lower than Canadian Olympic soccer players 10.8%, Australian soccer players 10.7%, U.S.A professional soccer players 11.6%, U.S.A national soccer players 11.5%, Kuwaiti world cup soccer players 9.9% and Brazilian soccer players 10.7%.

Pulmonary functions

Table 2: Selected pulmonary function measurements of the players

Variables	Mean (S. d.)
FVC (*l*)	5.3(±0.6)
$FEV_{1.0}$ (*l*)	4.2(±0.6)
$FEV_{1.0}$ (%)	63.4(±4.0)
MVV(l/min^{-1})	157.0(±26.0)

FVC = forced vital capacity, $FEV_{1.0}$ = forced expiratory volume at 1s, MVV = maximum voluntary ventilation

Table 2 indicates that pulmonary function variables measured in this study was only normal limit for the age group 18-35 years of the Indian people. FVC 5.3*l* value appear to be comparatively lower than those of first division league Yugoslavian players 5.9*l*, English league players 6.1*l* and U.S.A professionals 6.31*l*.The mean of $FEV_{1.0}$ 4.2*l*, FVC% 63.4*l* and MVV 157.0 *l*/min^{-1} in this study was not a high efficiency of the respiratory muscles at which air can be breathed in and out to supply the oxygen transport system. The subjects exhibited lower pulmonary values compared with other endurance athletes such as international cross-country runners FVC6.9*1*and MVV 227.5*1* because of the intermittent bursts of intense action in which players frequently rely on anaerobic mechanism system.

Cardio respiratory fitness

Table 3: Selected aerobic capacity and cardio respiratory fitness Bengalee elite soccer players

Variables	Mean (s. d)
Vo_{2max} (*l* /min^{-1})	3.2(±0.3)
VO_{2max}(ml/ kg^{-1}/min^{-1})	52.7((±4.2)
HR_{max} (beats/ min^{-1})	176((±6)
VE_{max} (*l* /min^{-1})	129((±11.3)
0_2 pulse (ml/ $beat^{-1}$)	20((±2.2)
Respiratory exchange ratio (RQ)	1.09((±0.07)
Vo_2 at anaerobic threshold (ml/ kg^{-1}/min^{-1})	40.2((±4.3)
AT (% Vo_2max)	72.0((±6.2)
Heart rate at anaerobic threshold (beats/ min^{-1})	147((±6)
AT (% HRmax)	82.4((±3.6)

The selected aerobic capacity and cardio respiratory fitness of the subjects were presented in Table 3. The Mean of VO_{2max}52.7 ml/ kg^{-1}/min^{-1} for the subjects appeared to lower than the values reported for a group of top level Australian players 62 ml/ kg^{-1}/$min^{-1}$the German national team 63 ml/ kg^{-1}/min^{-1}, the Swedish national team 61 ml/ kg^{-1}/min^{-1} and the national Canadian team 59.7 ml/ kg^{-1}/min^{-1}. The maximal aerobic power of elite soccer players seems to have values around 61-67 ml/ kg^{-1}/min^{-1}.The higher aerobic capacity is a critical factor in determining success. The mean of maximal heart rate 176 beats/ $min^{-1}$of the subjects tended to be lower than that of the 1978 Argentina team 194 beats/ min^{-1} and Austrian national team 191 beats/ min^{-1}. The mean values of VE_{max} for soccer players varied from 118.3(18.2) *l* /min^{-1} to 155.6 *l* /min^{-1}. The values found in the present study 129.0 *l*/ min^{-1} was within the range but well below the upper range value. The mean oxygen pulse value of the subjects 20ml/$beat^{-1}$ appeared to lower in comparison with the highest average values reported for a German league team 29.1ml/$beat^{-1}$, 1974 and 1981 national German teams 27.91ml/ $beat^{-1}$ and 28.21ml/ $beat^{-1}$. The anaerobic threshold percentage of Vo_{2max} was72ml of the Bengalee players was relatively low compared to well train athletes in world wide. The ATs researcher viewed that the Bengalee soccer players can not be the specific inclusion of intermittent, high-intensity exercise in their training program. A previous study reported on heart rate values during the game indicated that the heart rate was above 85% of maximum for two-thirds of the time and the average oxygen consumption during a normal game can be close to 80% of maximal oxygen uptake. Mean value of heart rates of 157to175 beats/min^{-1} was recorded from English league players' and players in the Swedish team during a match. It is interesting to note that the anaerobic threshold data collected in the present study was only 72% of VO_{2max} and HR_{max} was 83.5% with 147 beats/ min^{-1} was much lowered than any top FIFA ranking teams. The researcher opined that more competitive football match require for Bengalee soccer players and increase intensity of exercises to develop their anaerobic threshold level.

Flexibility and endurance capacity

Table 4: Selected Flexibility and distance covered test scores of soccer players

Variables	Mean(s.d)	Range
Sit and reach (cm)	30.2(±6.1)	(15.0-44.0)
Distance in 12 min (m)	2572(±252)	(2480-2775)

Field test data for flexibility showed in Table 4 have similar compared with other studies of soccer players. In general soccer players were less flexible than other sports men due to tight quadriceps and hamstring muscles in the lower extremities and need for specific stretching to increase the range of motion in order to reduce the incidence of soccer injuries. The mean 12-min run for distance 2572 m in the present study was comparatively lower than the Dallas Tornado professionals 2993 m and the Brazilian national soccer team 3540 m.

Anaerobic power

Table 5: Anaerobic power tests of players

Parameters	Mean (s. d.)
Alactic power work (W/kg-^{1})	14.3(±2.6)
Alactic work index (J/kg-^{1})	109(±22)
Lactic work index (J/kg-^{1})	302(±29)

The anaerobic power data of Bengalee soccer players presented in Table 5. The Mean alactic power index 14.3 *w/kg-^{1}*, alactic work index 109*J/kg-^{1}* and lactic work index 302*J/kg-^{1}* found in this study were comparatively lower than athlete of international cyclists, badminton players, squash players and swimmers. A test on a bicycle ergo meter used to evaluate maximal anaerobic alactic power in national Swedish soccer players, found a value of 19.5W $^{kg-1}$. This is approximately 10 to 13% higher than the untrained controls. A stair-run test to measure the anaerobic power of olympic soccer players in one study found that anaerobic power was less than in deca-athletes, sprinters and middle-distance runners. The soccer players in the present study were found only mediocre in anaerobic power.

Conclusion

This is the first and most comprehensive study of physiological investigation on Bengalee elite soccer players to the investigator's knowledge. The test data is provide a good line of reference for coaches, sports physiologists, nutritionists, strength and conditioner and future investigators. Information gathered from literature concerned with physiological status showed that the Bengalee players appeared to smaller, lower in cardio respiratory fitness and anaerobic power in comparison with different soccer players of Mid-east Asia, Europe and America. The study suggests that if the team wants to achieve reasonable success in international competition need to improve in physical fitness and emphasize in addition to skill training.

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