Baltic Journal of Health and Physical Activity

Volume 11 | Issue 2 Article 1

2019

# Comparison of body composition, physical fitness parameters and skeletal muscle damage indices among young Indian male soccer & hockey players

Surojit Sarkar
*Sports Authority of India, Netaji Subhas Eastern Center, Salt Lake City, Kolkata, India*

Subhra Karmakar Chatterjee
*Sports Authority of India, Netaji Subhas Eastern Center, Salt Lake City, Kolkata, India*

Swapan K. Dey
*Sports Authority of India, Netaji Subhas Eastern Center, Salt Lake City, Kolkata, India*, drsk_dey@rediffmail.com



## Recommended Citation

Sarkar S, Chatterjee S, Dey SK. Comparison of body composition, physical fitness parameters and skeletal muscle damage indices among young Indian male soccer & hockey players. Balt J Health Phys Act. 2019;11(2):1-10. doi: 10.29359/BJHPA.11.2.01

**Baltic Journal of Health and Physical Activity 2019; 11 (2): 1-10**
Journal of Gdansk University of Physical Education and Sport
e-ISSN 2080-9999

**ORIGINAL**

**doi: 10.29359/BJHPA.11.2.01**

# Comparison of body composition, physical fitness parameters and skeletal muscle damage indices among young Indian male soccer and hockey players

**Authors' Contribution:**
**A** Study Design
**B** Data Collection
**C** Statistical Analysis
**D** Data Interpretation
**E** Manuscript Preparation
**F** Literature Search
**G** Funds Collection

**Surojit Sarkar[BCDEF], Subhra Chatterjee (*nee* Karmakar)[AD], Swapan K. Dey[AG]**

Sports Authority of India, Netaji Subhas Eastern Center, Salt Lake City, Kolkata, India

## abstract

**Background:** The present study was aimed to evaluate the evidential comparison of anthropometric, body composition, physical fitness parameters and muscle damage indices between soccer and field hockey players.

**Material and methods:** Forty-one young Indian male players (including soccer, N = 18, and hockey, N = 23) were evaluated for anthropometric parameters (height, weight, BMI, BMR), and physical fitness variables (grip strength, back strength, flexibility, $VO_2$max, anaerobic power) using standard procedures. Body composition (fat mass, fat free mass, cell mass, muscle mass, fluid content, glycogen, minerals, body density) was assessed by using multi-frequency bioelectrical impedance analyzer (BIA). Muscle damage indices (lactate dehydrogenase, LDH; creatine kinase, CK-MB) were measured via standard spectrophotometric assay protocols.

**Results:** Grip strengths and $VO_2$max were found to be significantly higher among field hockey players, whereas lower values were found for relative anaerobic power (Wpower). LDH and CK-MB were found to be higher in soccer players. The correlation study depicts a positive relation between Wpower and LDH (r = 0.307, insignificant) and CK-MB (r = 0.330, $p < 0.05$).

**Conclusions:** Field hockey players have better muscular coordination and body balance with generous endurance capacity as they have higher strength indices and $VO_2$max. Higher glycolytic capacity and sprinting ability was found among soccer players.

**Key words:** body composition, strength indices, $VO_2$max, relative anaerobic power, lactate dehydrogenase, creatine kinase.

## article details

**Article statistics:** **Word count:** 3,161; **Tables:** 6; **Figures:** 0; **References:** 33
**Received:** November 2018; **Accepted:** April 2019; **Published:** June 2019

**Full-text PDF:** http://www.balticsportscience.com



**Indexation:** Celdes, Clarivate Analytics Emerging Sources Citation Index (ESCI), CNKI Scholar (China National Knowledge Infrastructure), CNPIEC, De Gruyter - IBR (International Bibliography of Reviews of Scholarly Literature in the Humanities and Social Sciences), De Gruyter - IBZ (International Bibliography of Periodical Literature in the Humanities and Social Sciences), DOAJ, EBSCO - Central & Eastern European Academic Source, EBSCO - SPORTDiscus, EBSCO Discovery Service, Google Scholar, Index Copernicus, J-Gate, Naviga (Softweco, Primo Central (ExLibris), ProQuest - Family Health, ProQuest - Health & Medical Complete, ProQuest - Illustrata: Health Sciences, ProQuest - Nursing & Allied Health Source, Summon (Serials Solutions/ProQuest, TDOne (TDNet), Ulrich's Periodicals Directory/ulrichsweb, WorldCat (OCLC)

**Funding:** This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

**Conflict of interests:** Authors have declared that no competing interest exists.

**Corresponding author:** Corresponding author: Dr. S. K. Dey, Senior Scientific Officer, Sports Authority of India, Human Performance Laboratory, Netaji Subhas Center, Salt Lake City, Kolkata-700106, India; e-mail: drsk_dey@rediffmail.com.

## INTRODUCTION

An athlete's acceleration, agility, endurance capacity, explosive power, and muscular strength indices can be influenced by the body morphology, whereas the body composition affects the strength and acceleration [1]. Morphological and physiological fitness for match play depends upon the work rate requirements for the athlete's physical training regimen, frequency of competition, stage of the competitive season, etc. [2]. Sarkar et al. [3] also reported the vital role of physique, body composition, hydration level, strength variables and nutritional status of an athlete to predict the performance level.

Exercise-induced muscle damage following a high intensity workout session, particularly in pre-competitive training session includes repeated muscle action, is hypothesized to be either mechanical, metabolic or both in nature [4–6]. Nybo et al. [5] suggested reduced power, increased creatine kinase (CK) and lactate dehydrogenase (LDH) levels as the most significant indicators of muscle damage [5]. CK and LDH are released from the sarcoplasm into the blood stream as a result of disruption in the sarcomere due to repeated high intensity exercise [7]. Conversely, lower values may point to inadequate training loads not promoting the adaptation [4].

Soccer and field hockey are both similar in nature, but the player's physiological demands are different as the skill-related physical fitness components, i.e., agility, body balance, coordination, power, reaction time and speed, are meant to be different in a sport-related manner [8]. Many studies have tried to reveal the comparative differences between soccer and hockey by mostly identifying general anthropometry [9–11], fitness parameters [9–11], or cardiac efficacy [12]. At the same time, studies involving muscle damage indices along with fitness profile and body composition are rare.

However, there have been numerous rule changes in both games, especially in hockey which transforming it into a faster and more skilful game [11]. As a result, there is a lack of recent research on the comparative assessment of physiological and muscle damage characteristics of elite young male soccer and hockey players.

The aim of the present study was to characterize the muscle damage indices along with the physical fitness parameters and body composition profile in both groups. The study also intended to establish a statistical relationship between muscle damage markers, body composition and some fitness variables during the pre-competitive phase.

## MATERIAL AND METHODS

### Subjects

The present cross-sectional study was carried out on 41 young Indian male players (including 18 soccer players, mean age = 15.4 ±1.75 years and 23 field hockey players, mean age = 15.8 ±1.85 years) living in the Eastern part of India. The sample size was calculated by using PS Power and Sample Size Calculation version 2.1.30. Type I error probability for a two-sided test is 0.05. Power (probability of correctly rejecting the null hypothesis of equal population means given n pairs of patients and a Type I error probability) is 0.8. The difference in population means (δ) = 20. Standard deviation within the group (σ) = 13. Therefore, the calculated Sample Size was 8. However, considering 20% drop out, performers with minimum 4 yrs of formal training history and came from the Eastern part on India. The players had similar socio-economic status and dietary habits and they were clinically examined by physicians of sports medicine just before commencing the study protocol [13]. A complete explanation of the procedures, potential risks and benefits of the tests were explained to all the subjects, and signed consent was obtained prior to the testing.

## Training regimen

The systematic training program was formulated by the qualified coaches under the guidance of scientific experts. The implemented training regimens were similar for both games except the skill training, and it was applied on an average of 4 to 5 hours with warm-up and cool-down sessions before and after the main practice every day except Sundays. Both morning and evening sessions comprised physical and skill training for one and two hours each, respectively. Physical training included different strength, speed and endurance training as well as flexibility exercises. Sports specific strength and endurance training followed. The players were also provided with psychological training sessions beside the technical and tactical training.

## Anthropometric and various fitness measures

Physical characteristics, i.e. standing height (cm) was measured to the nearest 0.1 cm using a Seca Alpha stadiometer (model – 213, Seca Deutschland, Germany), and body weight (kg) was measured to the nearest 0.1 kg using calibrated Seca alpha weighing scales (model 770) following the standard procedure [14]. The Body Mass Index (BMI) was calculated [15]. Handgrip strength (kg), relative back strength (/kg body weight) and trunk flexibility (cm) were measured with the help of a handgrip dynamometer (Grip-D, Takei A5401, Takei Scientific Instruments Co., Ltd., Japan), a back strength dynamometer and a sit-reach flexometer (Lafayette Instrumental co, USA) using standard procedures [16].

## Evaluation of aerobic and anaerobic power

A modified 20m multistage fitness test (Beep test) was conducted to measure the maximal aerobic capacity ($VO_2max$). Players had to maintain the running speed over the 20m distance with the increasing frequency of 'beep' sound. The final estimation of $VO_2max$ was found from the shuttle scores by using a standard chart of the beep test [5]. Running-based Anaerobic Sprint Test (RAST) was conducted to measure the players' power output. Six consecutive sprints were done with maximum acceleration and a 10-sec break after each sprint. Each sprint time was recorded by using the Brower timing gate system (Brower Timing Systems, USA) [5]. Absolute peak power was the maximum power found among 6 runs of each individual, and the relative peak power (Wpeak) was then calculated. Anaerobic power of each run and Wpeak were calculated from the following formula:

- Power = (Weight × Distance $^2$) ÷ Time $^3$
- Relative peak power = (Absolute peak power ÷ body weight)

## Body composition

Body composition, including body fat mass (FM, %), fat free mass (FFM, kg), total body water (TBW, %), TBW:FFM, extra cellular water (ECW, %), ECW:FFM, intra cellular water (ICW, %), ICW:FFM, ECW: ICW, body cell mass (BCM, kg), BCM: weight, muscle mass (MM, kg), MM: weight, total body potassium (TBK, gm), total body calcium (TBCa, gm), glycogen (gm) and minerals (kg), weremeasured using multi-frequency Bioelectrical Impedance Analyzer (BIA) with the standard procedure (Maltron Bioscan 920-2, Made in UK) [5].

## Measurements of biochemical parameters

Blood samples were obtained from the antecubital vein in a random condition. Immediately after blood collection, both of the tests for lactate dehydrogenase (LDH, U/L), creatine kinase (CK-MB, U/L) and hemoglobin (Hb, mg/dl) were done via standard protocol. Hemoglobin (Hb) levels were determined using a Beckman Coulter Gen S system (Beckman Coulter Inc., Fullerton, CA, USA) [17].

## Measurements of CK-MB

CK-MB assay is based on the dephosphorylation of creatine phosphate, the liberated ATP being linked to the glucose/hexokinase/glucose-6-phosphate dehydrogenase reactions. N-acetyl cysteine is used to reactivate the enzyme, which is rapidly inactivated due to the oxidation of the sulphydryl groups in the active site of the enzyme. The rate of NADPH formation, measured photometrically is proportional to the catalytic concentration of CK-MB and the CK-MB activity also measured at 340 nm [18].

Percentage of CK-MB activity in the sample:

$$\frac{\text{CK-MB Activity}}{\text{CK Total Activity}} \times 100 = \%\ \text{CK-MB Activity}$$

## Assay for lactate dehydrogenase (LDH)

The lactate dehydrogenase method is based on the conversion of pyruvate to lactate, at a temperature of 37°C and a total reaction time of 120 s. A measured amount of serum – diluted threefold – is added to the strip, which contains pyruvate and NADH. Lactate dehydrogenase activity is measured by means of reflectance spectroscopy, by the rate of the disappearance of NADH at 340 nm with reference to a calibration curve generated using lactate dehydrogenase calibrators [19].

## Statistical analysis

Statistical Program for Social Sciences (SPSS) version 16.0 for Windows (SPSS Inc., Chicago, Il, USA) was used to analyze the dataset of the present study. All values were expressed as means ±standard deviation (SD). Differences in the variables between the groups were analyzed through an independent sample t-test. Pearson correlation was run between some vital parameters to establish the relationship. Scatter plots including a regression equation were also done. A confidence level at 95% ($p \leq 0.05$) was considered as significant.

## RESULTS

Table 1 presents a comparison of various anthropometric parameters between male soccer and hockey players. No significant differences were identified for the following variables: age, height, weight, BMI and BMR. However, hockey players were found to be slightly heavier than soccer players in a height balanced manner.

Table 2 reveals a comparison of body fluids and hydration status between soccer and hockey players. No significant differences were identified for the following body fluid parameters: TBW, TBW:FFM, ECW, ECW:FFM, ICW, ICW:FFM, ECW:ICW, plasma volume.

Table 1. A comparison of various anthropometric parameters between male soccer and field hockey players

| Parameters | Soccer players (n=18) | Hockey players (n=23) | Level of significance (2 tailed) | t value |
|---|---|---|---|---|
| Age (yrs) | 15.4±1.75 | 15.8±1.85 | 0.539(NS) | -0.621 |
| Height (cm) | 167.4±7.90 | 167.9±5.78 | 0.827(NS) | -0.220 |
| Weight (kg) | 55.9±7.16 | 58.8±7.04 | 0.201(NS) | -1.302 |
| BMI ($kg/m^2$) | 20.0±1.97 | 20.6±1.52 | 0.294(NS) | -1.063 |
| BMR | 1768.4±164.57 | 1787.9±134.17 | 0.679(NS) | -0.417 |

*Values are mean ± SD, NS = not significant, BMI= Body mass index, BMR= Basal metabolic rate.*

Table 2. A comparison of body fluid levels between male soccer and field hockey players

| Parameters | Soccer players (n=18) | Hockey players (n=23) | Level of significance (2 tailed) | t value |
|---|---|---|---|---|
| Total Body Water (%) | 60.9±11.06 | 60.4±4.73 | 0.836(NS) | 0.208 |
| TBW:FFM | 0.7±0.11 | 0.7±0.02 | 0.684(NS) | -0.413 |
| Extra Cellular Water (%) | 35.6±4.94 | 34.5±6.08 | 0.524(NS) | 0.643 |
| ECW:FFM | 0.4±0.05 | 0.4±0.04 | 0.650(NS) | 0.457 |
| Intra Cellular Water (%) | 64.4±4.94 | 65.5±6.08 | 0.524(NS) | -0.643 |
| ICW:FFM | 0.8±0.09 | 0.8±0.14 | 0.313(NS) | -1.023 |
| ECW/ICW | 0.6±0.12 | 0.5±0.14 | 0.585(NS) | 0.551 |
| Plasma volume (lt) | 2.7±0.71 | 2.6±0.69 | 0.620(NS) | 0.500 |

*Values are mean ± SD, NS = not significant, ECW/ICW= Extra cellular water/Intra cellular water.*

Table 3 represents a comparison of body composition between soccer and hockey players, where all the following variables showed no significant differences between them. BF %, FFM, protein mass and TBCa were found to be slightly higher in hockey players than in soccer players, whereas a slightly higher value in body density was identified among soccer players than in their hockey peers.

Table 4 depicts a comparison of physical fitness parameters between soccer and hockey players. Handgrip strength (right side, $p < 0.05$ and left side, $p < 0.01$), $VO_2$max ($p < 0.001$), Wpower (relative anaerobic power, $p < 0.05$) were found to be significantly higher in male hockey players than in their soccer peers. However, soccer players were found to be insignificantly more flexible than hockey players.

Table 3. A comparison of body composition parameters between male soccer and field hockey players

| Parameters | Soccer players (n=18) | Hockey players (n=23) | Level of significance (2 tailed) | t value |
|---|---|---|---|---|
| Body Fat (%) | 15.6±5.38 | 17.5±6.87 | 0.338(NS) | 0.969 |
| Fat Free Mass (kg) | 47.2±6.81 | 48.5±6.68 | 0.551(NS) | -0.601 |
| Body Cell Mass (kg) | 26.6±3.87 | 26.9±3.02 | 0.786(NS) | -0.274 |
| BCM: weight | 0.5±0.04 | 0.5±0.02 | 0.056(NS) | 1.966 |
| Muscle Mass (kg) | 23.3±3.67 | 23.8±3.03 | 0.611(NS) | -0.513 |
| MM: weight | 0.4±0.03 | 0.4±0.03 | 0.226(NS) | 1.231 |
| Protein mass (kg) | 8.5±2.29 | 9.5±1.73 | 0.106(NS) | -1.655 |
| TBK (gm) | 125.1±17.9 | 128.1±14.46 | 0.556(NS) | -0.594 |
| TBCa (gm) | 947.8±184.90 | 957.2±133.28 | 0.851(NS) | -0.190 |
| Glycogen (gm) | 434.3±66.36 | 437.0±57.22 | 0.890(NS) | -0.139 |
| Mineral (kg) | 3.2±1.01 | 3.4±0.61 | 0.606(NS) | -0.519 |
| Body density (kg/lt) | 1.2±0.70 | 1.1±0.02 | 0.312(NS) | 1.042 |

*Values are mean ± SD, NS = not significant; TBK= Total body potassium, TBCa= Total body calcium, BCM= Body cell mass..*

Table 4. A comparison of physical fitness variables between male soccer and field hockey players

| Parameters | Soccer players (n=18) | Hockey players (n=23) | Level of significance (2 tailed) | t value |
|---|---|---|---|---|
| HGS-R (kg) | 38.8±4.58 | 41.6±4.10 | 0.050* | -2.012 |
| HGS-L (kg) | 38.4±4.19 | 42.6±4.67 | 0.005** | -3.003 |
| RBS (/kg wt.) | 2.0±0.21 | 2.0±0.20 | 0.628(NS) | -0.488 |
| Trunk flexibility (cm) | 15.1±7.0 | 12.8±3.05 | 0.202(NS) | 1.314 |
| $VO_2$max (ml/kg/min) | 46.5±4.51 | 53.5±4.26 | 0.000*** | -5.087 |
| Absolute anaerobic power (watt) | 418.8±110.88 | 383.5±72.61 | 0.226(NS) | 1.231 |
| Relative anaerobic power (watt/kg) | 7.4±1.42 | 6.5±0.85 | 0.023* | 2.416 |

*Values are mean ± SD,*= p<0.05, **= p<0.01, ***= p<0.001, NS = not significant; HGS-R= Handgrip strength (Right), HGS-L= Handgrip strength (Left), RBS= Relative back strength.*

Table 5 reveals a comparison of some biochemical parameters between male soccer and hockey players. After the comparison, LDH and hemoglobin were found to be significantly ($p < 0.05$) higher in soccer and hockey players, respectively. However, a higher prevalence of CK-MB was identified in soccer players but in a statistical insignificant manner.

Table 5. A comparison of some biochemical parameters between male soccer and field hockey players

| Parameters | Soccer players (n=18) | Hockey players (n=23) | Level of significance (2 tailed) | t value |
|---|---|---|---|---|
| LDH (U/L) | 253.3±64.11 | 219.8±32.78 | 0.036* | 2.171 |
| CK-MB (U/L) | 31.1±15.08 | 26.6±4.60 | 0.236(NS) | 1.223 |
| Hemoglobin (mg/dl) | 14.4±0.83 | 15.0±0.91 | 0.018* | -2.466 |

*Values are mean ± SD,*= p<0.05, NS = not significant; LDH= Lactate dehydrogenase, CK-MB= Creatine kinase (MB isoenzyme).*

Table 6 presents the correlation coefficient between some vital parameters with RBS, Wpower and $VO_2$max from the combined data of the studied young male athletes. Only CK-MB positively and significantly ($p < 0.05$) correlated with relative anaerobic power. On the other hand, LDH and CK-MB positively correlated with RBS and anaerobic power output but negatively correlated with $VO_2$max. All three fitness indices positively correlated with relative BCM, relative MM and negatively correlated with FM% but in a statistical insignificant manner.

Table 6. Pearson correlation between some body composition variables and biochemical marker enzymes with vital physical fitness parameters

| | RBS | Wpower | $VO_2$max |
|---|---|---|---|
| FM % | -.145 | -.181 | -.054 |
| Relative_BCM | .167 | .254 | .033 |
| Relative_MM | .003 | .277 | .048 |
| LDH | .192 | .307 | -.203 |
| CK-MB | .055 | .330* | -.118 |

**= p<0.05, FM%= Fat mass %, Relative_BCM= ratio of BCM: weight, Relative_MM= ratio of MM: weight, LDH= Lactate dehydrogenase, CK-MB= Creatine kinase (MB isoenzyme), RBS= Relative back strength, Wpower= Relative anaerobic power, $VO_2$max= Maximum oxygen consumption.*

## DISCUSSION

Soccer and field hockey are similar in nature, but the player's physiological profiles are different as the skill-related physical fitness components are meant to be differ among both the games [8]. These games have specific demands for the body size, shape, body fluids concentrations, minerals content, cardiovascular endurance, muscular strength, body balance etc., which are the most important prerequisites to succeed in the competition [20]. The present study provides a clear difference between the games when compared for the muscular strength, endurance capacity and anaerobic power along with some marker enzymes for skeletal muscle damage.

Physique, including height and weight, plays a vital role for better performance [21]. The present study identified field hockey players as slightly heavier than soccer players, while the age and height have no such differences. This difference in body weight may be due to the higher proportion of FM% and FFM in the same group. The present result may count as advantageous for hockey players, as both the games belong to high contact division play where a good amount of fat can reduce the chance of injury during play [20]. However, the reduced FM% in soccer players may also depict their higher ability to accelerate and gain speed during the game [2].

Significantly higher handgrip strength for both hands (right, p=0.05 and left, p=0.005) was found among hockey players which might help them to hold the stick firmly and to take a forceful strike in the proper direction [22]. This significantly higher muscular isometric strength may be due to the muscular hypertrophy and higher protein mass content among hockey players than in soccer players, and the same was proved by Hoffman et al. [23]. The similar content in body weight balanced BCM, MM along with ions and mineral balance in both the present groups may depict the identical muscular hypertrophy development and muscular contractility after systematic training [3].

Body's hydration status is a measure of athlete's performance as hypohydration (>2% body mass loss) can impair endurance performance [6]. However, performance in team sports (i.e., soccer, hockey) is dependent upon cognitive functioning (e.g., attention, decision of passing, reaction time, etc.), the execution of sport-specific technical skills (e.g., shooting, passing, dribbling, etc.) and related to the hydration status. The present study showed no significant differences between the variables of hydration and the fluid status. This may indicate the similarity in exercise intensity of workouts during training sessions and as well as during playing sessions [24].

Aerobic capacity certainly plays an important role in modern field hockey and has a major influence on technical performance and tactical choices [22]. The present study depicted a significant increase in $VO_2$max ($p < 0.001$) in hockey players than their soccer counterparts. The increase in the peripheral factor gradient, i.e. muscle capillary and mitochondrial density, may be acting as responsible factors for improving $VO_2$max in the field hockey players [25]. Bassett and Howley [26] also observed an increase in $VO_2$max which might be due to a certain increase in cardiac output as a result of muscular over perfusion during exercise. According to some researchers, the probable reason against the improvement in $VO_2$max might be the increase in left ventricular (LV) muscle mass, LV contractility during exercise, stroke volume which ultimately increased the cardiac output [27, 28].

In the present study, relative anaerobic power output was found to be significantly ($p = 0.023$) higher in soccer players which may indicate the higher lactate tolerance of these players than their hockey counterparts [29]. The present result may confer the higher sprinting ability of soccer players within the anaerobic zone and depict a higher glycolytic activity level [30, 31]. However, some studies corroborate the same result of improved anaerobic power output even at the lactate threshold point in sedentary men [29]. MacDougal et al. [31] reported that short but intense sprint training (around ≥ 90% HRmax) can enhance glycolytic and oxidative enzyme activity, as well as maximum short-term power output.

The activity levels of CK and LDH have been used as indicators against muscle damage due to high intensity exercise under resistance or aerobic training [8, 9]. In the present study, relative anaerobic power positively correlated with the resting value of LDH ($r = 0.307$, insignificant) and CK-MB ($r = 0.330$, $p < 0.05$). Although LDH was found to be significantly higher among the group of soccer players, along with the significantly higher relative anaerobic power, which may confer the involvement of excessive moderate to high intensity eccentric phase muscle activity [9]. Increase in the resting LDH activity for up to 24 hours may result from the immunological and hormonal changes due to stress-tension association with aerobic and resistance training [32]. Moreover, Urhausen and Kindermann [33] said that some athletes show only small increases in CK activity and that was due to a lower permeability of muscle cell membranes.

## CONCLUSIONS

Systematic training within the hydration limit corroborates more muscular damage (increased CK and LDH) among the soccer players than among the hockey players, which was associated with the reduction in muscular strength and endurance in the same group. On the other hand, creatine kinase showed a significant positive relationship with relative anaerobic power. The study may also reveal a higher glycolytic activity and sprinting ability of soccer players by better maintenance of the anaerobic zone with higher relative anaerobic power. Overall, this type of study can help to strengthen the database of South-East Asian team athletes and can be used as baseline data for future research.

## LIMITATION OF THE STUDY

The present study does not have any sedentary data (control group) to compare. It does not conclude the positional variance between the playing groups as the data were not collected as per the playing position.

## REFERENCES


[1] Nancy R, Nancy M, Langley S, et al. Nutrition and Athletic Performance. Medscape. 2010.

[2] Chatterjee S, Chatterjee P, Bandhyopadhyay A. Validity of Queen's College Step Test for estimation of maximal oxygen uptake in female students. Indian J Med Res. 2005;121(1):32-5.

[3] Sarkar S, Debnath M, Chatterjee S, et al. Assessment of Nutritional Status, Body Composition Parameters & Physiological Profiles of Young Male Taekwondo and Wushu Players. Int J Sports Sci Med. 2018;2(1):001-7.

[4] Singh G, Soodan JS, Kumar S. The relationship between creatine kinase and cortisol level of young Indian male athletes. J Exer Sci Physiotherapy. 2014;2:111-113. https://doi.org/10.18376//2014/v10i2/67143

[5] Nybo L, Girard O, Mohr M, Knez W, Voss S and Racinais S. Markers of muscle damage and performance recovery after exercise in the heat. Med Sci Sports Exerc. 2013;45(5):860-868. https://doi.org/10.1249/MSS.0b013e31827ded04

[6] Foschini D, Prestes J. Acute hormonal and immune responses after a bi-set strength training. Fit Perform J. 2007;6:38-44. https://doi.org/10.3900/fpj.6.1.38.e

[7] Tolfrey K, Jones AM, Campbell IG. The effect of aerobic exercise training on the lipid-lipoprotein profile of children and adolescents. Sports Med. 2000;29:99-112. https://doi.org/10.2165/00007256-200029020-00003

[8] Singh K, Kumar R. Comparative study of selected physical fitness components between hockey and soccer players of university level. Int J Academic Res Development. 2018;2(3):345-347.

[9] Ajayaghosh MV. Comparative study of selected fitness variables among men football and hockey players. Int J Physiol Nutrition Physical Edu. 2017;2(2):792-794.

[10] Singh K, Kumar R. Comparative study of selected physical fitness components between hockey and soccer players of university level. Int J Academic Res Development. 2018;2(3):345-347.

[11] Prajapat A, Ahmed I, Khan Z, Ali K, Hussain ME. Cardiac autonomic profile of soccer field hockey and basketball players: a comparative study. Asian J Sports Med. 2018;9(2):e62492. https://doi.org/10.5812/asjsm.62492

[12] Durandt JJ, Evans JP, Revington P, Jones AT, Lamberts RP. Physical profiles of elite male field hockey and soccer players – application to sport-specific tests. SAJSM. 2007;19(3):53-55. https://doi.org/10.17159/2078-516X/2007/v19i3a257

[13] SAI: Sports Authority of India National Sports Talent Contest Scheme, Spotting and Nurturing of Sport Talent. Appendix D. 1992:110-116.

[14] Hawes MR, Martin AD. Human body composition, In: Kinanthropometric and exercise physiology laboratory manual: test, procedures and data second edition. Volume 1: anthropometry. London, Routledge, 2001. (chapter 1)

[15] WHO. Physical status: the use and interpretation of anthropometry. Report of a WHO expert committee. World Health Organ Tech Rep. 1995;854:1-452.

[16] Debnath M, Roy M, Chatterjee S, Dey SK. Body composition profile of elite Indian male and female archers a comparative study. IJHPECSS. 2016;23(1):19-25.

[17] Bozkaya G, Ozgu E, Karaca B. The association between estimated average glucose levels and fasting plasma glucose levels. Clinics (Sao Paulo). 2010;65(11):1077-80. https://doi.org/10.1590/S1807-59322010001100003

[18] Young DS. Effects of disease on Clinical Lab. Tests, 4th ed AACC 2001.

[19] Stevens JF, Tsang W, Newall RG. Measurement of the enzymes lactate dehydrogenase and creatine kinase using reflectance spectroscopy and reagent strips. J Clin Pathol. 1983;36(12):1371-1376. https://doi.org/10.1136/jcp.36.12.1371

[20] Dey SK, Kar N, Debray P. Anthropometric, motor ability and physiological profiles of Indian national club footballers: a comparative study. S Afr J Res Sport Phys Educ Recreation. 2010;32(1):43-56. https://doi.org/10.4314/sajrs.v32i1.54089

[21] Dey SK, Jana S, Bandopadhyay A. Effect of training on various anthropometric and physiological profiles of Indian national women soccer players. European J Sports Exerc Sci. 2015;4(1):1-9.

[22] Manna I, Khanna KL, Dhara PC. Effect of Training on Body Composition, Physiological and Biochemical Variables of Field Hockey Players. Advances in Applied Physiology. 2016;1(2):31-37. https://doi.org/10.11648/j.aap.20160102.13

[23] Hoffman JR, Ratamess NA, Kang J, Flavo MJ, Faigenbaum AD. Effects of protein supplementation on muscular performance and resting hormonal changes in college football players. J Sports Sci Med. 2007;6:85-92.

[24] Nuccio RP, Barnes KA, Carter JM, Baker LB. Fluid balance in team sport athletes and the effect of hydration on cognitive, technical and physical performance. Sports Med. 2017;47:1951-1982. https://doi.org/10.1007/s40279-017-0738-7

[25] Henriksson J, Sundberg CJ. Generelle effekter av fysisk aktivitet [General effects of physical activity]. In: Bahr R, editor. Aktivitetshåndboken: fysisk aktivitet i forebygging og behandling [Activity Handbook: Physical activity in prevention and treatment]. Oslo: Helsedirektoratet; 2008, 8-36. Norwegian.

[26] Bassett DR, Howley ET. Limiting factors for maximum oxygen uptake and determinants of endurance performance. Med Sci Sports Exerc. 2000;32(1):70-84. https://doi.org/10.1097/00005768-200001000-00012

[27] Slørdahl, SA. Atrioventricular plane displacement in untrained and trained females. Med Sci Sports Exerc. 2004;36(11):1871-75. https://doi.org/10.1249/01.MSS.0000145444.01292.3D

[28] Debray P, Dey SK. A companion of the point of deflection from linearity of heart rate and the ventilatory threshold in the determination of the anaerobic threshold in Indian boys. J Physiol Anthropol. 2007;26(1):31-37. https://doi.org/10.2114/jpa2.26.31

[29] McCarthy JP, Agre JC, Graf BK, et al. Compatibility of adaptive responses with combining strength and endurance training. Med Sci Sports Exerc. 1995;27:429–36. https://doi.org/10.1249/00005768-199503000-00021

[30] Neumann G, Shephard RJ, Astrand PO. Endurance in sport. The encyclopedia of sports medicine. Oxford: Blackwell Scientific Publications; 1992. https://doi.org/10.1249/00005768-199212000-00015

[31] MacDougall JD, Hicks AL, MacDonald JR, McKelvie RS,Green HJ, Smith KM. Muscle performance and enzymatic adaptations to sprint interval training. J Appl Physiol. 1998;84(6):2138-2142. https://doi.org/10.1152/jappl.1998.84.6.2138

[32] Walsh NP, Gleeson M, Shephard RJ, Gleeson M, Woods JA, Bishop N, Fleshner M, Green C, Pedersen BK, Hoffman-Goete L. Position statement part one: immune function and exercise. Exerc Immunol Rev. 2011;17:6-63.

[33] Urhausen A, Kindermann W. Diagnosis of overtraining. Sports Med. 2002;32(2):95-102. https://doi.org/10.2165/00007256-200232020-00002

Cite this article as:

Sarkar S, Chatterjee (nee Karmakar) S, Dey SK.
Comparison of body composition, physical fitness parameters and skeletal muscle damage indices among young Indian male soccer & hockey players
Balt J Health Phys Act. 2019;11(2):1-10
doi: 10.29359/BJHPA.11.2.01