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Physiological, Biochemical and Strength Profile of Indian Cyclists and Boxers - A Comparative Study

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Abstract: ***Objectives: The purpose of this study was to assess and compare the physiological, strength and biochemical profile of Indian national cyclists and boxers. Methodology: 60 national level athletes (30 boxers and 30 cyclists) consented to participate in the study. Their physiological (VO2 max), biochemical (CK, MPO, hs-cRP), Isometric strength at the knee joint and anaerobic performance (average power and maximum height) were assessed. Results and Conclusion: The results indicated the Indian national cyclists had higher VO_2 max(57.1 ml $min^{-1}kg^{-1}$) as compared to national boxers (51.13 ml $min^{-1}kg^{-1}$) whilst, the biochemical markers depicted more muscle damage in cyclists, making them prone to exercise induced muscle injuries.***

Keywords: Exercise induced muscle damage, Cyclists, Boxers, Isometric muscle strength, VO_2 max.

1. Introduction

For more than 20 years, scientists have examined the characteristics of successful athletes. In the last two decades, there has been significant accumulation of scientific data regarding athletic physiology.[1] Aspects such as body composition, strength, endurance, balance and anaerobic power are among other factors, of prime im evaluation of athletes.[2,3]. Few sports are as physiologically challenging as competitive cycling.[4] Professional road cycling is one of the most performed endurance sports in the world.[5] In such sports a time-distance relationship for internationally competitive athletes is well established.[6] Certainly, road cyclists face a wide variety of terrains and competitive situations, given the different competition formats that now exist.[7] The training control of such a demanding sport is a crucial tool for coaches' feedback and includes many laboratory and field testing variables.[8] Likewise, Boxing is an intermittent sport characterized by short duration, high intensity bursts of activity.[9] It requires significant anaerobic fitness, and operates within a well-developed aerobic system. Boxing is estimated to be 70-80% anaerobic and 20-30% aerobic [11]. The nature of boxing requires athletes to sustain power at a high percentage of maximal oxygen uptake (VO2max) [9]. Few studies have been reported in the literature about the cardiovascular and metabolic demands of boxing [10-12]. Previous studies on Indian boxers concentrated mainly on body composition, muscle strength, aerobic capacity, and anaerobic power of Indian Boxers [10-13]. Few studies investigated the biochemical, morphological and physiological characteristics [9] of Indian boxers.[14,9] An understanding of the characteristics of internationally competitive cyclists and boxers and demands of competition is useful for the coaches and support staff working with professional athletes this information helps to clarify fitness goals and establishes physiological traits that are prerequisites for success.[6] Unfortunately such data is not available especially in Indian athletes. Thus there is a lacuna, on studies documenting the fitness and strength characteristics of different athletes. Therefore, the present work focused on the muscular strength, physiological and biochemical markers especially muscle damaging markers in Indian national cyclists and boxers.

2. Material and Methods

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ed male athletes aged 18-28 years , national game players, boxing and cycling (mean ± SD age, 20.3 ± 1.49 y; stature, 172.27 ± 6.42 cms; body mass, 64.73 ± 5.44 kgs; BMI, 21.8 ± 1.24 kg/m^2 and mean ± SD age, 20.03 ± 1.19 y; stature, 168.57 ± 4.5 cms; body mass, 61.74 ± 4.55 kgs; BMI, 21.71 ± 1.08 kg/m^2 respectively) consented to participate in the study. All participants engaged themselves in specific, regular training at least 6 hours a day and five days a week during the competitive season. All volunteers provided a written, informed consent to participate in the study protocol and prior to the start of data collection, the study protocol was approved by institutional ethical committee, Faculty of Sports Medicine and Physiotherapy, Guru Nanak Dev University, Amritsar. Readings of the participants was taken in the morning on their rest days, which is the 6^{th} day/7^{th} day of the week.

Blood samples were drawn from each participant via standard venipuncture from the median cubital or cephalic vein in the antecubital space of the forearm.[15] Sample was analyzed for creatine kinase and C-reactive protein using assay kits from DiaSys Diagnostic Systems GmbH. (Holzeim, Germany). Plasma myeloperoxidase was analyzed using ELISA kit from BioVendor, Research and Diagnostic Products. (Brno, Czech Republic).

Isometric muscle strength was assessed using HUR 5340 leg extension/curl computer controlled machine is an isoinertial dynamometer which was used for evaluating isometric peak torque [16] of both the quadriceps (extension) and the hamstrings (flexion) at the knee joint of both the limbs.

Subjects were instructed to perform a warm up session consisting of two sets of sit ups followed by stretching of hamstrings and quadriceps prior to the attempt. The participants were seated on the HUR leg extension machine, and their thighs were strapped down by using inelastic straps with Velcro closures to ensure quadriceps isolation. The length of the lever arm was adjusted according to each participant height such that the pads of the lever arm rested above the ankle joint. Test joint angles were set at 120 degrees for extension movement and 140 degrees for flexion movement and the axis of rotation was aligned with the lateral condyle of femur. Two attempts, each for extension and flexion by both the limbs were performed. During the attempt participants were instructed to contract their respective muscle (i.e Quadriceps for extension and Hamstrings for flexion) as forcefully as possible pushing their legs against the pad of the lever arm. At the end, the attempt was analyzed using the HUR Labs Research Line 3.0 software to get the peak torque in Nm for both the quadriceps and hamstrings muscles of both the limbs and the best of the 2 attempts were accepted for statistical analysis.

To assess the maximum aerobic capacity (Vo2max) a portable gas analyzer MetaMax 3B (Cortex, Germany) integrated with a motorized treadmill h/p/cosmos mercury [cos 10198-01] (Germany) were used. Prior to commencing the test each participant was told about the incremental exercise test protocol, continuous electronic heart rate monitoring throughout the test. The participant performed an incremental test to volitional exhaustion in accordance with the Bruce protocol [17] on a motorized treadmill. Each participant was equipped with a heart rate monitor (Polar T34 transmitter, Kempele, Finland) and a mask (Hans Rudolph V, Shawnee, Kansas, USA) before entering the test treadmill. [18] Maximum oxygen uptake was measured using an open circuit breath by breath automated precalibrated gas analysis system (Cortex MetaMax 3B, Germany) directly transferred to a computer using Cortex Metasoft (version 3.9) software. Vo2 max was determined based on a plateau in Vo2 consumption or participant reaching volitional fatigue.[19]

Anaerobic power was assessed using Kinematic measuring system (Fitness technology, Sky, Australia). The system consists of a contact mat used to measure absolute and relative anaerobic power. Following a familiarization session participants performed a counter movement jump standing on the contact mat in which, on command from a standing position, they descended rapidly (to approximately a 90° knee angle) and performed a maximal vertical jump, tapping the contact mat on landing with both the feet. For each vertical jump performance maximum height and absolute power were measured and analyzed using the associated software. A total of three attempts were recorded whereby the best attempt was accepted for further analysis.[20]

3. Statistical Analysis

The data were analyzed using SPSS software version 17.0(SPSS,Chiago, IL,USA).Descriptive statistics (mean ± SD) of all the variables of both cyclists and boxers were calculated and their changes were analyzed from Mann-Whitney U test at a significance level at $p<0.05$.

4. Results

Table 1: Descriptive statistics of boxers and cyclists and comparison of mean values using Mann-Whitney U test

Parameter	*Game*	*Number*	*Mean± Standard Deviation*	*u*	*Significance*
Age(yrs)	1	30	20.3±1.49	420.5	p>0.05, NS
	2	30	20.03±1.19		
Height(cms)	1	30	172.27±6.42	294.0	p<0.05, S
	2	30	168.57±4.5		
Weight(kg)	1	30	64.73±5.44	301.5	P<0.05, S
	2	30	61.74±4.55		
BMI(kg/m^2)	1	30	21.8±1.24	443.0	p>0.05, NS
	2	30	21.7±1.08		
hs-cRP (mg/L)	1	30	2.37±0.7	33.0	p<0.01, S
	2	30	3.99±0.56		
CK(IU/L)	1	30	115.01±13.17	29.0	p<0.01, S
	2	30	143.01±9.84		
MPO(ng/L)	1	30	5.78±1.01	34.0	p<0.01, S
	2	30	9.46±1.13		
Iso R Ext(Nm)	1	30	196.17±19.45	424.0	p>0.05, NS
	2	30	194.37±16.07		
Iso R Flex(Nm)	1	30	91.93±11.78	380.5	p>0.05, NS
	2	30	93.83±9.46		
Iso L Ext(Nm)	1	30	173.87±11.69	355.0	p>0.05, NS
	2	30	178.37±9.9		
Iso L Flex(Nm)	1	30	87.17±11.13	437.0	p>0.05, NS
	2	30	86.6±9.93		
VO_2 ($mlmin^{-1}kg^{-1}$)	1	30	51.13±3.07	97.0	p<0.01,S
	2	30	57.1±3.9		
MH (metres)	1	30	0.37±0.06	229.0	p<0.01, S
	2	30	0.42±0.05		
AVG.P (watts)	1	30	826.47±136.9	230.5	p<0.01, S
	2	30	944.43±120.84		

*- cRP-c-reactive protein, CK-creatine kinase, MPO-myeloperoxidase, Iso R/L Ext/Flex- isometric right/left knee extension/ flexion, VO2-maximum oxygen consumption, MH- maximum height, AVG. P- average power.

Table-1 depicts the baseline characteristics of Indian National boxers and cyclists. The result shows significant difference between the means of all biochemical parameters, hs-CRP(cyclists-2.37±0.7, boxers-3.99±0.56), CK (cyclists-115.01±13.17, boxers-143.01±9.84)and MPO (cyclists 5.78±1.01, boxers-9.46±1.13) , maximal oxygen uptake (cyclist-51.13±3.07, boxers-57.1±3.9) and anaerobic performance, maximum height(MH) (cyclist-0.37±0.06, boxers-0.42±0.05) and average power (cyclist-826.47±136.9, boxers-944.43±120.84) but in isometric muscle strength of right knee joint in extension direction (cyclist-196.17±19.45, boxers- 194.37±16.07), left knee joint in extension direction (cyclist-173.87±11.69, boxers-178.37±9.9) ,right knee joint in flexion direction (cyclists-91.93±11.78, boxers- 93.83±9.46), left knee joint in flexion direction (cyclist-87.17±11.13, boxers-86.6±9.93) and heart rate(cyclist-172.57±13.01, boxers-177.9±10.65) the difference was not significant.

5. Discussion

The aim of the present study was to assess and compare the baselines of Indian national cyclists and boxers in terms of

their muscle strength, hematological and physiological profile. The main findings show that the Indian national cyclists have a better aerobic capacity which is reflected by a high mean value of maximum oxygen consumption (VO_2 max). the above finding corroborate with the literature suggesting endurance training increases maximum oxygen consumption [21], whilst there was no statistically significant difference in the isometric muscle strength at knee joint of both dominant and non dominant sides, the most notable finding are significantly high mean values of biochemical markers of muscle damage (hs-cRP, CK and MPO) in cyclists as compared to boxers. This result is supported by the fact that endurance training increases the number of mitochondrial and specific enzymes [22] and yields stress in the muscle fibres. [21-22]

Creatine kinase, a surrogate index of muscle damage is more indicative of damage or gaps in the sarcolemma and hence causing the cytosolic enzymes to 'leak' from the cell into the blood. [23] Furthermore, better anaerobic power (maximum jump height and average power) in cyclists as compared to boxers found in the present study is supported by the evidence that strength and power share equal importance with endurance training. Maximal strength influences power performance and an increase in maximal strength is usually connected with an improvement in relative strength and therefore with improvement of power abilities. [24]

6. Conclusion

In summary, these data provide us relevant information about the normative baselines of physical fitness of Indian national cyclists and boxers. In addition, national cyclists had better aerobic capacity (VO2 max- 57.1 ml $min^{-1}kg^{-1}$) as compared to our national boxers. Strenuous endurance training of road cycling also depicted high muscle damaging indices which makes them more prone to exercise induced muscle injuries. Further, these data could be useful for defining modified training patterns to reduce subsequent muscle injuries.

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8. Conflict of Interest

The Authors declare that they have no conflict of interest.

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