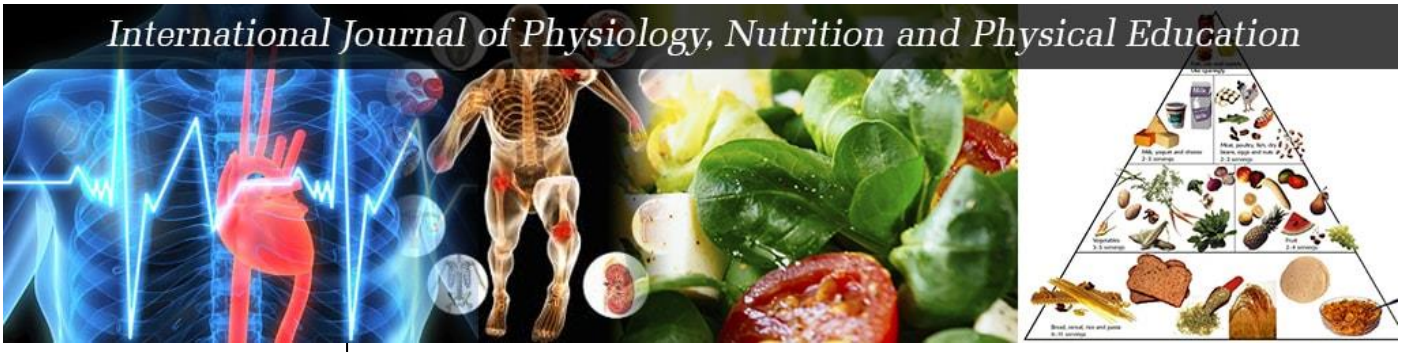

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Morpho-physiological status of Indian cyclists at SAI, NCA

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Abstract
29 international competitive cyclists from National Cycling Academy, Sports Authority of India were assessed for their anthropometric and physiological profile during pre-competitive season. Detailed anthropometric measurements were taken following standard techniques and procedures as per ISAK guidelines and notified anthropometric instruments. Body composition was calculated using Siri's equation and Durnin-Wormsley formula. Heath and Carter method of somatotyping was used to find body physique.VO2 max was calculated using Astrand protocol on a MONARK LC 7 Bicycle Ergometer. SAI, NCA cyclists were found to be (165.58±6.70 cm) tall and lean (Body fat 10.16±2.26 %) with average leg length (skelic index 90.46±5.96) and sitting height (86.98±3.88 cm). They possess strong and flexible core with back strength (84.5±26.95 kg), sit and reach flexibility (41.7±7.5 cm) and VO2 max of 53.10±7.65 l/min/kg.

Keywords: Anthropometry, endurance, somatotype, profiling, monitoring

Introduction
Cycling is majorly an endurance sport which requires powerful skeletal muscles and high aerobic capacity. It is a game where interaction between physical force and a mechanically driven device determines the performance of the individual. Cycling majorly consists of three events namely sprint, time trial and pursuit. In all the three events the rider requires specific body size, shape and composition to take biomechanically advantageous riding position, combat resistance and execute various motions required (Craig and Norton, 2001) [1]. Interclass anthropometric and physiological differences arise at elite levels when players practice specialization in one particular event category. As a result, it becomes necessary to carry out studies on anthropometric and physiological demands of the game and its various events.

There have been relatively few studies to identify the key anthropometric and physiological variables associated with cycling performance both at national and international levels. McLean and Parker (1989) [2] described the relationship between anthropometry and performance of Australian track cyclists. Sprint cyclists were significantly heavier and stronger, and had larger chest, arm, thigh and calf girths than the endurance cyclists. However, no significant relationship was found between any anthropometric parameter and performance. Foley, Bird and White (1989) [3] found that shorter cycling events require higher mesomorphy than longer events. Also, time trialist and pursuiters were found to be taller than sprinters. They also found that skelic index (leg to height ratio) of endurance group was greater than sprinters.

In reference to body composition studies, it is a proven fact that fat mass adds up to the overall body mass without any contribution to deliverable force and thus low body fat content is desirable for success in almost every game (Norton, Olds and Olive, 1996) [4]. When talking about cycling, the undesirable and nonfunctional fat mass results into an increased energy cost, higher rolling resistance and greater projected frontal body surface area which ultimately act as retarding factors (Gregor, 2000) [5].

Regarding physiological requirement, it is very important for a cyclist to reach the desired maximal oxygen uptake (VO2 max) and sustain it thereafter avoiding large oxygen deficits (Craig, Norton and Bourdon, 1993) [6].

Craig, Walsh and Martin, 2000 in longitudinal study reported variation in the VO2 max levels throughout the study as function of training alterations during different training periods. As evident from the available literature, each cyclist is unique in terms of the event being played and thus each event requires a specific combination of anthropometric and physiological demands. The variation in genetic predisposition of different players allows the body and systems to respond differently to the same training stimulus. So, it becomes necessary to identify the players' trainability in terms of body proportions and physiological responses towards various games and suggest him/her to get specialized in the event player is best suited for.

Current study was conducted on 29 elite Road and Track Cyclists from National Cycling Academy, Sports Authority of India, Delhi during competitive period. Body size, shape, proportion and composition were assessed using anthropometric measurements. Physiological parameters included maximal oxygen uptake (VO2 max) using Astrand Protocol on Bicycle Ergometer. The results obtained were analyzed to understand the current anthropometric and physiological status of Elite Indian cyclists with respect to International players.

Methodology

Participants

National Cycling Academy, Sports Authority of India was approached for the study. 29 cyclists, 16 males and 13 females, practicing both Road and Track Cycling were chosen as participants with informed consent of the coaches during the competition season. The average age of the players was 15.13±0.87 years.

Procedure

General demographic information was collected from the players including training age, performance or achievements in various Regional and National Competitions and the events they practice. Subsequently, anthropometric and physiological tests were conducted.

Anthropometric measurements

18 anthropometric measurements were taken using standardized instruments and following ISAK protocol. The various measurements included stature, body weight, epicondylar humeri, epicondylar femori, relative limb lengths and circumferences. The measurements were used to study technically important segmental lengths, body proportions and other derived parameters like BMI, WHR, sum of skinfolds, somatotype, body composition. For finding the somatotype, the equations provided by Heath and Carter were used. To calculate body fat percentage Siri's equations were used. Body density was calculated using Durnin and Womersley (1974) [11] formula.

Body density, D = 1.1533 - (0.0643 X L) (for males)
D =1.1369 - (0.0598 X L) (for females)
Percent body fat = (495/body density-450)

Physiological assessment

Resting Heart Rate of the player was taken following which the player was asked to undergo general warm up session. After that, Polar H7 HRM Heart Rate Monitor was tied at the anatomical position on the chest of the player. Aerobic capacity was analyzed using the Astrand protocol on MONARK LC7 Bicycle Ergometer.

The players were first asked to undergo a basic warm up session following which core strength was measured using Back and Leg Dynamometer. Trunk flexibility was assessed using Sit and Reach test.

Statistical analysis

The data collected was checked for normal distribution curve and was further analyzed using SPSS software (version 17). Descriptive statistics were calculated for all the parameters. An estimated general profile of each elite Indian cyclist was prepared from the mean and standard deviation values obtained from the statistical analysis.

Result and Discussion

Average anthropometric and physiological parameters of the NCA cyclists can be represented as follows:-

Table 1: Anthropometric parameters among SAI, NCA cyclists

S no	Parameter	Mean	Std. Dev
1	Age (yrs)	15.13	0.87
2	Height (cm)	165.58	6.70
3	Weight (kg)	56.75	8.37
4	Body Mass Index	20.65	2.31
5	Sitting Height (cm)	86.98	3.88
6	Skelic Index	90.46	5.96
7	Sum of skinfolds (mm)	23.79	4.71
8	Waist Hip Ratio	0.79	0.03

Table 2: Average body composition and somatotype of SAI, NCA cyclists

S no.	Parameter	Mean	Std. Dev
1	Body Fat %	10.16	2.26
2	Fat Free mass %	89.83	2.26
3	Endomorphy	2.03	0.56
4	Mesomorphy	3.92	1.36
5	Ectomorphy	3.06	1.25

Table 3: Strength and flexibility status of SAI, NCA cyclists

S no.	Parameter	Mean	Std. Dev
1	Sit and reach flexibility (cm)	41.7	7.5
2	Back Strength (kg)	84.5	26.95
3	Back strength/ weight Ratio	1.46	0.34

Table 4: Physiological parameters obtained from Astrand Test

S.no.	Parameter	Mean	Std.dev
1	Accepted Heart Rate (bpm) (used to calculate VO2 max)	128.5	7.34
2	Load Astrand (N)	541.07	13.01
3	VO2 max (l/min/kg)	53.10	7.65

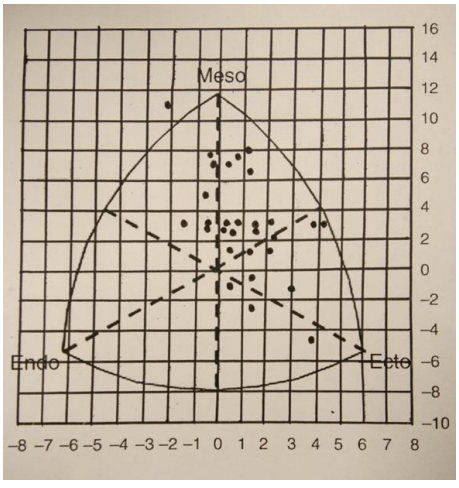

Fig 1: Somatotype of SAI, NCA cyclists

Discussion

The study conducted outlines the morphological and physiological characteristics of elite SAI, NCA cyclists. The participants belong to a range of events from sprint requiring sudden bout of strength and speed to pursuit and time trial where the body has to sustain long duration of continuous physiological demands.

The average morphology of SAI, NCA cyclists has been represented with the help of mean and std. dev of anthropometric measurements. Based upon the results obtained, it can be argued that an average cyclist is tall and light with average leg length and sitting height. Tall stature and light body represents an ideal athletic body. Also, average leg length results into energy efficient paddling which is not possible with very long or short lower limbs. Average sitting height instead of a long trunk favors the reduction in total trunkal area projected and hence reducing the active air drag.

Body composition parameters in table. 2 show that an ideal cyclist is lean and muscular possessing ectomorphic-mesomorph physique (fig.1) to meet the physiological needs of strength and endurance. Strong core and flexible body (table.3) help to maintain the typical bent down riding posture.

Aerobic capacity is an athletic trait which is highly trainable and also baseline values of which are genetically determined (Bouchard, Dionne and Simoneau, 1992) [8]. It is beneficial for an event like cycling, to select players having a good baseline aerobic capacity which may be as a result of genetic predisposition. Further training of such players will enhance the aerobic capacity to a better level. Aerobic capacity of SAI, NCA cyclists was found to be VO2 max 53.10±7.65 l/min/kg at accepted heart rate of 128±7.34 bpm and average workload 541.07±13.01N (table 4). The values indicate that the aerobic capacity can be further trained following training schedule with 50-60% endurance component. Nevertheless, aerobic capacity will also show improvement owing to biological and physiological development of children during post adolescence. Their average age is 15.13±0.87 years which is the most crucial window for enhancement of aerobic capacity of these players. Our conventional training system believes in pushing the players to their maximum capacities through long and continuous sessions of practice. The method helps the athlete to reach that individual maximum but after that a plateau is reached with no further improvement in the performance. The reason behind it is a unit increase in performance depends upon cubic increase of power output which is a combination of physical attributes and efforts. So, to increase speed by one unit, a cubic increase in efforts is required. Alternatively, what can be done is to bring into play the scientific technicalities which can reduce the energy requirements and bring out large improvement in performance (Craig, Kevin and Norton, 2001) [1].

Each cyclist possesses a unique combination of morphology and physiology and thus responds differently to the training regime implemented. By taking care of these specific individual profiles during talent scouting, sorting the right talent into right event becomes more systematic, scientific and logical.

Conclusion

Cycling for good performance and winning in competitions requires scientific planning and long term developmental pathway wherein various performance parameters are trained at the appropriate time during the growth & development of the player. Sports skills can be trained much earlier starting from ages 8 to 12 years which is the most receptive time for learning. Power, Strength, Endurance and Speed can be trained after the adolescent spurt or after attaining Peak Height Velocity. The present study on adolescent cyclists involved assessment of their anthropometric and physiological adaptations towards a systemic training protocol. It can be seen that the cyclists are gifted with the structural and anthropometrical requirements as per the demands of the game, and physiological requirements can be met with maximal training stimulus with minimum risk of injury or illness (i.e. adequate recovery). All this needs a balance between the training load/intensity with the optimum recovery. The early signs of over training need to be recognized and to ensure the each cyclist's individual needs are met.

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