A Study on Maximal Aerobic Capacity and Anaerobic Capacity Sports Persons

Manoj Kumar

Abstract – The role of sport in society has been debated for many decades. Sport is a part of society as both an educational fixture and an entertainment enterprise. Sport forms part of human and social development; it can contribute to social cohesion, tolerance and Integration and is an effective channel for physical and socioeconomic development. As a universal language, sport can be a powerful medium for social and economic change: it can be utilized to bridge cultural gaps, resolve conflict and educate people in ways that very few activities can. Sport is characterized by a hierarchical organization in which the level of performance of a player is described by the appropriate level of competition (e.g., local, regional, national, and international). Expert performance in sports can be defined as the consistent superior athletic performance over an extended period (Strakes et al , 1993).

INTRODUCTION

Athletes are constantly striving to improve performance and searching for the winning edge. Because athletes have become more powerful and athletic performances have continued to improve with improvements in training methods. Scientists, coaches and athletes are constantly searching for improvements in performance by assessing methods that can enhance athletic ability. Warren et al explained that exceptional achievement of today's athletes is a result of an integration of many factors such as, training, genetics, health status, psychology, physiology, biomechanics and skills.

Because now sports in the modern world has become a science where various scientific equipment are being used for conducting experiments on the sports persons and from the results the scientist arrived at some conclusion at higher efficiencies of the athletes. Allawy & Radhwan and Ahmed agreed that the scientific measurements are of the most important means of evaluating athletes performance in general, either standing on their general or particular physical capabilities for specialized activities they practiced or acknowledging the strength, weak points and the extent of progress for individual performance in the programs and also determine the attributes and characteristics of players in terms of kinetic, physical, physiological, mental aspect as well as to determine the level of the performance for the player.

According to Hassaneen (2000), evaluation, the field of sport training, plays a positive role in raising the level of performance either in senior level or junior level. Evaluation is a process that judges the measurements results and objective tests in the light of specific considerations for the performance specification. During the past twenty years there have been great developments in the scientific understanding of the role of Exercise Physiology in health and physical performance. Exercise physiology is a scientific discipline that focuses on how an organism responds to exercise. Exercise represents one of the greatest stresses that an organism can encounter. Therefore exercise represents an outstanding model for studying human and animal physiology.

In order for Exercise Physiologists to construct and implement specific training programs, they must have access to the fundamental information concerning the qualities that contribute to successful athletic performance. This may include the development of a functional training model to determine the relative contributions and kinetics of metabolism and other physiological factors that contribute to performance. Knowledge of the kinetics of Metabolism and complete understanding of the physiologic components that influence performance will enable exercise physiologists and trainers to effectively prescribe specific training programs, develop adequate assessment protocols and maximize training and competitive performance.

Multiple physiological variables influence athletic performance. Like those variables that influence performance, percent body fat, VO_2max, the anaerobic threshold, anaerobic power, running economy and anaerobic capacity. Several of these variables can distinguish between highly trained and untrained subjects. However, within the trained population there is considerable variability for each. For example, highly trained athletes tend to have higher VO_2 max values than untrained individuals. These high VO_2 max values are partly responsible for the better endurance performance of the highly trained runner. The same cannot be said about a group of highly trained athletes: the person with the highest VO_2 max values are not necessarily the best runners, nor vise versa. There are many examples in the literature of outstanding athletes with modest VO_2 max values or relatively untrained individuals with outstanding VO_2 max values . So, physiological testing helps athletes and coaches in many ways.

Major benefit of the evaluation of these physiological variables is that they allow us to better isolate specific components related to performance. Maximum aerobic capacity is one of the most important physiological variables, as it represents the ability of an organism, to utilize atmospheric oxygen for cellular energetics (Sharon, 1984, and Shepard, 1986 and Astrand and Rodahl, 1986).

Developed countries in Europe and United States have provided valuable information in various physiological aspects (Cunnigham, 1973; Bonen et al., 1979; Macek and Vavra, 1980; Kemper, 1985 and Shephard 1986). In Asian region, Japan, Malaysia and China are the leading countries to study the physiological responses to ergometry in children (Matsui et al, 1971; Kobayashi et al, 1978, and Tanaka and Shindo, 1985). However, most of the scientific work in Asian countries had been focused on the evaluation of cardio-respiratory responses in sportspersons.

The most thorough method of estimation of cardiopulmonary testing is a direct measurement of the oxygen uptake at the maximal exercise test. Maximum aerobic capacity best measured directly in the athlete by determining maximal rate of oxygen consumption is the single best measure of an athletes maximum ability to take in oxygen from the air, load it into the blood, and transport it to the working muscles to sustain exercise aerobically. “Aerobic fitness” refers to endurance, or the ability to sustain work for prolonged periods. It represents the ability of the cardiovascular and respiratory systems to accommodate the oxygen needs of the muscular system over a sustained period of time, as in endurance events such as distance running, swimming and bicycling.

Every activity which may be very individual has a desirable speed of performance that is combined with a maximal level of useable strength (Ellis et al 1998, Rushall and Pyke 1990). This is important when considering power in regards to performance. Abernethy et al (1995) additionally suggests that strength and power can be considered the forces or torques generated during sporting activity. Because strength is a component of power it must also be considered an important factor when measuring performance.

Brukner and Kahn (1997) note power as the equivalent of explosive strength. This relates to the so called power events such as jumps, sprints and throwing events where the athletes body is propelled – by jumping or sprinting or an external object is projected such as a shot or javelin (Watson 1986).

Body composition assessment measures the percentage of fat mass and lean body mass. It can be an important tool in helping an athlete to achieve his or her ideal weight to optimize performance. A lack of lean body mass impedes strength and endurance and increases susceptibility to injury. To improve lean body and reduce fat mass, it is important for an athlete to engage in a scientifically designed sports-specific nutrition and exercise program. Athletes who carry too much body fat for their sport may experience decreased performance through compromised speed, agility premature fatigue, and injury. To help design an effective nutrition and exercise program, athletes should consider consulting with a registered dietitian and exercise physiologist for professional guidance.

OBJECTIVES OF THE STUDY:

The present study was undertaken with following aims and objectives:

1. To examine the status of selected Physiological variables (maximal aerobic, anaerobic capacity and anaerobic power output) among different group of sports persons.

2. To study the status of selected morphological variables (Body fat %, muscle mass, bone mass, somato-type) among in different group of sports persons.

3. The study also enables to find out the relationship between morphological and physiological variables among the different groups of sportspersons.

HYPOTHESIS

The study made of the following hypothesis:

1. It was hypothesized that there would be the differences in morphological and physiological variables among the different groups of sportspersons.

2. It was hypothesized that there may some relationship between morphological and physiological variables among the different groups of sportspersons.

SIGNIFICANCE OF THE STUDY

In sports fraternity, records and scores may not be there for long. They are usually being broken constantly. This now appears to be axiomatic that records of performance and human endurance will go on registering new heights in the days to come. The present study may be significant in the following ways:

1. The study may help to set up the target of physiological variables to be achieved, keeping in view the physiological demand in different sports categories.

2. The study may help to identify the training related changes in various sports categories and its physiological adaptation.

3. The morpho-physiological variables selected for this study, from various sports, can be a frame of reference, for assessing the implication of training and its effectiveness, keeping in view, the growth and developmental aspects underneath various sports categories.

4. The study would provide additional evidence either to substantiate or negate the findings of the studies reported in other sports dominated countries.

5. The study would promote enthusiasm and interest among scholars for further research in the field of sports.

REVIEW OF LITERATURE:

According to MacDougall, Wenger and Green (1991) physiological testing of athletes is beneficial in four ways:

- It indicates the athlete's strengths and weaknesses in relation to their sport, whilst providing baseline data for individual training program prescriptions.

- It gives the athlete and coach feedback, whilst assessing the effectiveness of training programs.

- It provides information on the health status of the athlete.

- It acts as an educational process by which the athlete learns to better understand their body and the demands of the sport.

In order for exercise physiologists to construct and implement specific training programs, they must have access to the fundamental information concerning the qualities that contribute to successful athletic performance. This may include the development of a functional training model to determine the relative contributions and kinetics of metabolism and other physiological factors that contribute to performance. Sport specificity is also important when testing aerobic capacity and trying to get an accurate picture of the aerobic demands of the sport being completed (Bergh et al., 2007).

The athletes in a particular sport must possess such typical characteristics which are of advantage to their performance. Body composition also makes an important contribution to an individual's level of physical fitness for performance, particularly in such sports that require one to carry one's body weight over a distance, which is facilitated by a large proportion of active tissue (muscle) in relation to a small proportion of fat tissue.

Saltin and Astrand (1967) stated that the maximum aerobic capacity is a determining factor in endurance events. Shepherd et al, (1968) states that maximum aerobic capacity as a result of endurance training, distance runners acquire a high relative VO2 max.

Kenney & Hodgson (1985) and Bunc et al, (1987) in a studied the maximum oxygen consumption of elite international cyclists . Ghosh et al (1988) reported that the relative VO2max of Indian long distance runners. Foley et al (1989) coducted upon 36 competitive male cyclists (mean age 23.4 years) who had been competing on average for 8.2 years. Cyclists were allocated to one of four groups; sprint, pursuit, road and time trial according to their competitive strengths. The sprint cyclists were significantly shorter and more meso-morphic than the other three groups.

The time trialists were the tallest, most ecto-morphic group, having the longest legs (p less than 0.01), the highest leg length/height ratio (p less than 0.05) and the greatest bitro-chanteric width (p less than 0.05). The pursuit and road cyclists were found to have similar physiques, which were located between those of the sprinters and time trialists. The biomechanical implications of these differences in physique may be related to the high rate of pedal revolutions required by sprinters and the higher gear ratios used by time trialists.

Ekblom,(1969); Pollock, (1973), and Daniels et al, (1978) stated since VO2 max is a test for assessing the running endurance, the distance runners who acquire a high

VO2 max, will obviously be at an advantage. VO_2 max improves with training but reaches a plateau at a certain time, whereas, continuous improvement of distance running performance has been observed.

Farrel et al (1979) studied on marathon runners. He found that VO2 max is positively correlated with high level marathon.Butts et al (1991) studied the VO2 on the triathlon found the positive correlation with the performance.

Londeree et al (1986) stated that appropriate tests can be used to accurately estimate: an individual's potential for success in long distance running; his current level of conditioning; his appropriate training and racing paces; and his ideal bodyweight. The proposed tests include the study of VO_2 max, running efficiency, maximal steady-state, and body composition.

Based on a review of the literature it was determined that VO_2 max, running efficiency, and body composition provide the information about long distance running potential, including specific paces for various events. Maximal steady-state running pace identifies appropriate running paces for various events. Relative maximal steady-state oxygen consumption identifies the current level of conditioning. A comparison of maximal steady-state, running efficiency, and body composition by assessing current status with optimums, provide guidelines for appropriate changes.

Research has shown that demonstrating a high aerobic capacity is important for success in track cycling events (Craig et al., 1993). The ability to rapidly reach and sustain high maximal oxygen uptake enables a large, rapid and sustained aerobic energy release that reduces the reliance upon a large proportion of the finite oxygen deficit. VO_2 max values above 90 ml/kg/min have been found to exist in many world class track cyclists. As high aerobic power is strongly associated with track cycling success, peak VO_2 max values in excess of 80 ml/kg/min for males and 70 ml/kg/min for females are considered prerequisites for successful world-class cyclists.

Because VO_2 max and its response to training are under strong genetic control, it becomes obvious that a high aerobic power base is mandatory for successful track cycling performance (Craig et al., 1993).

Jeukendrup et al.(2000) reported longitudinal changes in aerobic indices over a six year period for elite male 4000 m pursuit track cyclists. In terms of performance, Olds et al. (1993) predicted that a 15% improvement in VO_2 max (5.24 to 5.91 l/min) would enable a track cyclist to compete in the 4000m pursuit 15.5 seconds faster. Further, it has been demonstrated that elite cyclists exhibited physiological adaptations such as the ability to perform near 90% of VO_2 max over long periods of time. Therefore, the kinetics of VO_2 max among track cyclists has become a topic for research with regards to training protocols.

RESEARCH METHODOLOGY:

Research has shown that demonstrating a high aerobic capacity is important for success in track cycling events (Craig et al., 1993). The ability to rapidly reach and sustain high maximal oxygen uptake enables a large, rapid and sustained aerobic energy release that reduces the reliance upon a large proportion of the finite oxygen deficit. VO_2 max values above 90 ml/kg/min have been found to exist in many world class track cyclists. As high aerobic power is strongly associated with track cycling success, peak VO_2 max values in excess of 80 ml/kg/min for males and 70 ml/kg/min for females are considered prerequisites for successful world-class cyclists.

Because VO_2 max and its response to training are under strong genetic control, it becomes obvious that a high aerobic power base is mandatory for successful track cycling performance (Craig et al., 1993). Paterson et. al. (1979), pre-training VO_2 was not measured, and causality of the training cannot be determined. Since on-ice shifts in a typical hockey game last approximately 90 seconds (Paterson, 1979), these short bouts of high intensity exercise draw upon anaerobic metabolism, including the depletion of phosphor creatine stores, which are depleted in six to 10 seconds.

According to Randell et al, (1997) , the added weight will increase inertia and thus slow the rate of acceleration, secondly it will limit hill climbing ability, thirdly it will increase the rolling resistance on the tyres and lastly it will have a significant impact on the cyclist's frontal area.

Pregiffer (1997) observed that VO_2 max demonstrated to be a strong predictor of cycling performance in a 14 day stage race among trained female cyclists . Randall (1997) stated that there has been less emphasis on heart rate responses of elite cyclists in the literature, with maximal values reported by one group of authors as 188 bpm. Wadley and LeRossignol (1998) reported 20 meter sprints with 20 second recovery and found no significant difference between the recovery of those athletes with high aerobic capacity and those with lower aerobic capacity; however, this was not comparable to an on-ice hockey shift.

CONCLUSION:

The following conclusions are made:

1. In the present study an attempt was made to identify the physiological demand of sportsmen at different age categories.

2. The unique profile of different sports discipline related to energy system changes, should be taken into consideration while administering training to the miniature and young athletes in various sports.

3. The present data of morpho-physiological can be a handy tool and can act as a frame of reference for monitoring the athletes at different discipline.

4. Keeping in view of the growing demand of various sports in physical and physiological attributes, the endurance category sportsmen at elite age category need to improve their maximum aerobic capacity.

5. In the present study the intermittent category sportsperson need to achieve the physical and physiological target underlying that particular sport.

6. The physical and physiological variables of the sports person engaged in various sports need to be analysed at regular intervals and prompt counseling of the results, will enable the sportsperson to achieve higher level of sporting excellence.

This study is supportive of other studies that have investigated the same. Similar studies on Indian athletes will demonstrate the athlete's condition and could serve as a potential motivation, which leads to their much awaited superior performance in international arena.

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