

Dotan et al, (1983), Blimkie et al (1988), Horswill et al (1989) have done the similar type of study. Anaerobic power was found to be positively related to the bone mass and muscle mass in combative group of sportspersons. They observed the relations between the muscle mass and bone mass and power outputs.

CHAPTER V

SUMMARY & CONCLUSIONS

It is of great interest for all the Coaches and Sports Scientists that how training programs effect the athletic performance. These training programs include the combination of endurance and resistance training. Each training program includes an extensive period of aerobic development followed by interval training to increase both anaerobic performance & ability to recover from high-intensity activity in preparation for key events.

Medallist performance in sports competitions no longer occurs at random or as a result of chance alone. Apart from technique, tactics and skills, International level sports performance in various games and

sports, is the result of a complex blend of many factors which includes various physical and physiological components.

Keeping in view the relationship of body composition parameters with the physiological parameters the present study was designed to investigate the status of various physiological variables like maximum aerobic capacity, anaerobic capacity and anaerobic power of sportspersons. Attempt was also made to find out the relationship of these variables with body composition profile.

Maximum aerobic capacity (VO_2 max), anaerobic threshold level, anaerobic power and anaerobic capacity are the physiological parameters which can predict the performance of sports persons. These physiological parameters are the basic physiological fitness components and cannot be studied by excluding their relationship with the morphological parameters like height, weight, body fat percentage, somatotype etc.

Maximal aerobic capacity or VO_2 Max, the amount of oxygen consumed in one minute of maximal aerobic exercise, is widely considered the standard test for aerobic conditioning. Improving VO_2 Max is a crucial step in maximizing endurance performance in any event lasting four minutes or longer. The higher an athlete's VO_2 Max,

the greater the contribution of the aerobic system to energy production. This translates into greater endurance at any intensity.

The most common test of aerobic system is VO₂ Max. This procedure is used universally because sports scientists can measure oxygen consumption directly.

The anaerobic formation of ATP system occurs at immediate onset of exercise and also when body's muscle works the oxygen utilization system's capabilities (i.e. very high intensities). The oxygen debt, defined as the recovery oxygen uptake above resting metabolic rates, has been discredited as a valid and reliable measure of the anaerobic capacity as it is generally acknowledged that mechanisms other than the metabolism of lactate also contribute to the post-exercise oxygen uptake.

Following exercise, the body continues to need oxygen at a higher rate than before the exercise began. This sustained oxygen consumption is known as excess post exercise oxygen consumption (EPOC). After cardiovascular exercise, VO₂ max declines but remains elevated above pre-exercise levels. The length of time VO₂ remains elevated during post exercise is dependent on the intensity of exercise, the fitness level of the individual and number of factors e.g. body core temperature, exercise mode, nutritional status. The amount of oxygen

consumed during recovery that is above resting values is called excess post exercise oxygen consumption (EPOC).

EPOC is an indicator of intensity of exercise also called anaerobic capacity. It is a numerical value comprising the duration and intensity of the exercise. EPOC value as high as training that taxes large muscle groups (for example running or cross-country skiing). Weight training may feel very strenuous, because local muscle fatigue and lactic acid hinder performance even if your body still has energy for repetitions.

Power is normally indicated by the rapid ability of the muscle to shorten and produce contraction and it depends on the ability of the muscle to contract with speed and force. Anaerobic power is the power produced without the requirement for oxygen to be present. Sprinting, mainly at the end of a race, is predominately an anaerobic activity. Anaerobic literally means without oxygen. It relates to short-term high-energy production where the predominant fuels are produced without the necessity of oxygen. Tests for anaerobic performance aim to assess relatively short duration exercise bouts.

Body composition refers to the relative percentage of muscle, fat, bone, and other tissue of which the body is composed. The ideal

body composition varies with different sports, but in general the less fat mass, the greater the performance.

The regeneration of muscle ATP through anaerobic mechanisms is an essential feature of sports performance. This area of Exercise Physiology has been characterized by dramatic advances over the past 50 years. The present study has evaluated the maximal aerobic, anaerobic capacities and anaerobic power and their relationship with body composition profile. It may be useful for the coaches and the sports scientists to reschedule the training programs of sports like cycling, hockey, judo in order to achieve their maximal level.

A total of (178) sportspersons were selected as subjects for this study from the three different sports categories (Endurance, Combative & Intermittent). Each sports category consisted of 30 approximate sportsmen and 30 sportswomen of age group of 20-28 years. All the sportspersons were Elite level selected from the national level players who were represented India in different competitions.

The morphological variables included height, body weight, body fat percentage, muscle mass, bone mass and somatotype. Physiological functions are measured in the laboratory in terms of oxygen consumption, oxygen debt, anaerobic power and heart rate which is again dependent on other coordinated physiological

functions, particularly of circulatory, respiratory and muscular systems. For this purpose, maximum O₂ consumption (VO₂ max), O₂ debt and heart rate were measured independently. The instruments used for the measurements of the above tests were readily available at Exercise Physiology laboratory and Anthropometry laboratory of Sports Authority of India, Netaji Subhas National Institute of Sports, Patiala.

Instruments used for measurement of morphological variables were Stadiometer, Weighing machine, Skinfold caliper, Sliding Caliper, Steel tape. Instruments used for measurement of physiological variables. Bone mass and muscle mass was calculated by Matigka method. Measurements for VO₂ max and EPOC were done by metabolic Gas Analyser (K4, Cosmed Srl- Italy) and exercise was done on computerised bicycle ergometer (Erich Jaeger, Germany). Heart rate was measured by Polar Heart Rate Monitor.

The data obtained on morpho-physiological variables have been analyzed by Statistical Package of Social Sciences (SPSS) version 10 in order to compare the morpho-physiological variables of the subject's different groups of sports.

Results of present study reveals that there are significant differences in body height between intermittent vs endurance sports

categories. But no significant difference was observed between combative & intermittent and combative & endurance sports category. Cyclists have been found to tallest followed by hockey and judokas respectively.

This may be due to as combative sports require movement speed and coordination coupled with agility and explosive power, the taller individuals find it difficult to execute the skill, which are prerequisites for combative group.

Results reveals that there are significant differences in body weight between combative vs intermittent and endurance vs intermittent sports categories. But no significant difference was observed between combative vs endurance sports category.

Results reveal that there are significant differences in endomorphic components between combative vs intermittent and endurance vs combative sports categories. But no significant difference was observed between combative vs endurance and intermittent vs endurance sports category. Combative Sportspersonss were found to be highly endomorphic & mesomorphic as compared to endurance and intermittent sports.

Results reveal that there are significant differences in fat % between combative vs intermittent, endurance vs combative and

intermittent vs endurance sports categories. Combative sports were observed with highest fat % followed by cyclists and hockey both in male and female. Combative found having muscle mass and bone mass.

Result reveals that there are significant differences in maximum oxygen consumption between combative vs intermittent, endurance vs combative and intermittent vs endurance sports categories in male and female both. Endurance (cyclists) were found to have high aerobic capacity.

Results reveal that there are significant differences in Oxygen Debt (I) between all the three sports categories (combative vs intermittent, endurance vs combative and intermittent vs endurance) both in male & female.

The endurance group is showing significantly less O_2 debt than intermittent and combative group. This is due to the higher magnitude of training, addressed to develop anaerobic capacity for intermittent and combative categories. At elite level, the allocation of training stimulus towards speed-endurance in intermittent sports is relatively higher than endurance sports, which may reflect the difference in the present study.

High anaerobic capacity is an advantage in sprint or power events but the success in any type of activity requires technique, tactics and skill. Almost all the sport activities have aerobic and anaerobic components, the dominance depends on the intensity and duration of the game or activity. Combat category sports require fast and quick movements coupled with repeated fast punching in boxing and explosive action in judo and therefore rely more on anaerobic power, followed by intermittent sports (Football and Hockey), which require repeated short and long sprints and explosive power.

Anaerobic power reflects the ability of the adenosine triphosphate and phosphocreatine (ATP-PCr) energy pathways to produce energy for muscle contraction. This system is depleted quickly and is used for short bursts of intense power output. Sprint or track cyclists, sprint runners, hockey players, and other athletes that use short, high-intensity efforts benefit from training this system.

Athletes train hard to both improve their anaerobic power capacity and decrease their reliance on it by improving their aerobic endurance. By building their capacity to use power systems that do not

require oxygen, athletes can push themselves harder than aerobic activity alone would allow.

In the present study , Body Fat % was found to be related with Anaerobic power in the male and female endurance players (cyclists).Anaerobic power was also found to be related with body fat % and endomorphic component in male judokas, and significantly related with muscle mass and bone mass in female judokas.

Explosive power presented a new dimension of anaerobic power, i.e., how fast maximal energy for power development can be obtained, and its values are high in all sports activities that demand explosiveness and fast maximal energy production. Coaches or other experts in the field could, in the future, find useful to follow and improve, through training process, one of the variables that is most informative for that sport.

This indicates that the intermittent sportsmen are showing rapid recovery than the other two groups. In modern training, coaches rely on, intensive interval training with incomplete recovery, to improve recovery response. The intermittent category sports, which include

football and hockey and the faster recovery is a prerequisite for these sports to achieve excellence.

Result reveals that there are significant differences in recovery heart rate between all the three sports categories (endurance vs combative and intermittent vs endurance).

In the light of the findings drawn, 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 sportsperson engaged in various sports need to be analysed at regular intervals and prompt counselling 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.

References

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