CHAPTER - I

INTRODUCTION

In the modern world the records of track and field events are often broken and new records are set because of the new techniques and new training methods. Through training programmes an athlete can improve the strength, endurance and agility so that one can perform well in his athletic event.

Training has been a part of human language since ancient times. It denotes the process of preparation for some task. The preparation of a sportsman represents a multisided process of purposeful utilisation of the total complex of factors which help in the development of the sportsman and ensure a necessary level of his sports performance ability.

Sports training aims at achieving high performance in sports competitions. It is a process which is spread over a long period of time. It is a competition and performance oriented process.

Training programmes in athletics aim directly at the improvement of performance. That too, the interval training involves the aerobic quality of muscles fit for the activity. Interval training, as a means of improving the aerobic endurance, is mostly included in all the athletic training programmes.
Training and tactics play an important role in each sport and game. As a result of constant evolution, man is today running faster, jumping higher and throwing longer than ever before. For this rapid improvement a modern man follows several programmes, among which one is the Interval training.

1.1 SPORTS TRAINING

Sports training must be understood as a specialised process of all-round physical conditioning aimed at the methodical preparation of Athletes.

Sports training is the total process of preparation of a sportsmen, through different means and forms for better performance. The sports performance is the result and expression of the total personality of the sports man. The educational aspect of sports training is unfortunately overlooked frequently by coaches and physical education teachers in India.

1.2 INTERVAL TRAINING

Interval training involves activities that are more intermittent. It consists of alternating periods of relatively intense work and active recovery. It allows to perform more work at an intense work load over a long period of time than working continuously.¹

Interval training is alternate periods of intense work and active recovery.²

For the physiological system of the body to be fit, they must function well enough to support the specific activity, the individual is performing. Moreover, different activities make different demands upon the organism with respect to circulatory, respiratory, metabolic and neurological processes which are specific to the activity.

The lungs, heart and blood vessels perform vital functions on the body's supply system. They supply the muscles with the necessary fuels, oxygen and carry wastes such as carbon dioxide and lactic acid. Consequently, the cardiorespiratory system in the athlete needs to be developed.³

Exercise physiology and scientific training methods have been advanced so much during the past few years that a single group training programme is no longer applicable to people of all age groups. The research findings are rather conducive to exercise and training should be based on individual's specific needs, goals and physical capacities.⁴


1.3 INTERVAL TRAINING AND PHYSIOLOGICAL VARIABLES

The physiology of sport encompasses a wide and diverse range of scientific interests. The intention, and major challenge of the review, is to collate the most pertinent of these interests into a coherent strategy for future research in sports physiology. The unifying concept of this review is the potential contribution of future research in sports physiology to the development of the elite competitor. The review promotes this theme through an indepth appraisal of current knowledge and identification of key areas of research that would most profitably advance the understanding and application of sports physiology. Central to this theme are the physiological limitations to exercise performance of the elite competitor and the adaptation of these physiological systems to further training, possibly leading to overtraining.

Indeed, the potential to adapt to, or recover from, the ever increasing demands of training and competition is considered in sections on the development of strength and power, the child athlete and the limitations to performance in multiple sprint activities such as hockey and football. Throughout the review it is recognized that sports physiology is increasingly reliant upon advances in analytical techniques and quantitative measurements. Physiological measurement, the validity and accuracy of present and future procedures, and the correct interpretation of these data are therefore considered in detail in the final section of the review.  

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An individual's physical fitness depends on the co-ordinated functioning of the various physiological systems, namely respiratory system, blood circulatory system, skeleto-muscular system, nervous system, digestive system, excretary system and endocrine system. Each system has several parameters to assess its functions and its effect on the whole of physiology of a person. For example, expiratory system has the following parameters namely vital capacity, oxygen-consumption, gas exchange, tidal volume and carbondioxide production. In the same way the blood circulatory system has the following parameters: Pulse rate, stroke volume, systolic and diastolic pressure in the arteries and so on.

The pulse rate or heart rate and blood pressure are two parameters that belong to the blood circulatory system of physiology of the body. The reading of pulse beat per minute and the systolic and diastolic pressure of the arterial blood will indicate not only the function of the circulatory system but also help to find out how far the other systems of the body have been affected.

Pulse rate and blood pressure are affected both externally and internally. They are influenced by external causes like heavy work, labour, exercise and other environmental factors like heat, cold and altitude. In the same way they are controlled by internal causes, that is psycho-feelings like anger, joy, sorrow, stress, strain and other emotional and mental disturbances.
1.3.1. RESTING PULSE RATE AND INTERVAL TRAINING

The pulse rate in healthy persons is affected by age, body size, body position, food intake, time of day, emotions and physical activity. Most observations have shown that the pulse rate is definitely affected by body position. The rate is lowest in lying, higher in sitting, and highest in standing. The extent of variation however differs with the subject.6

Baley and Field7 state that the rate of heart beat may be influenced by body position, physical activity, altitude, digestive function, emotion, body temperature (fever), haemorrhage, hyperthyroidism, drugs and hormones. The rate is slower when lying down than while exercising or immediately following exercise, at low than at high altitude and when calm than emotional.

Karpovich8 advocates that men who are physically fit show a smaller difference between reclining and standing than do men in general. Pulse rate tends to be slower in athletes and non-athletes. A slow pulse rate in reclining and standing positions is usually regarded as a sign of excellent physical condition.

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6 James A. Baley and David A. Field, Physical Education and Physical Educator (Boston: Allyn and Bacon, Inc, 1971) P.278.
7 Peter V. Karpovich, Physiology of Muscular Activity, (Philadelphia: W.B. Saunders Company, 1966), P.164.
8 Ibid., P.165.
1.3.2. INTERVAL TRAINING AND BLOOD PRESSURE

As a result of training, the blood pressure recovery process following exercise is improved. The healthier the individual, the quicker does his blood pressure return to the pre-exercise level. In addition, during heavy work, the untrained subject experiences a progressive fall in systolic pressure, whereas training retards the appearance of this phenomenon so that heavy work can be continued for a relatively longer period of time without any significant change in blood pressure.

Michael et al., conducted the study to find out the pulse wave and Blood Pressure changes occurring during a physical training programme of the members of Santa Barbara Basketball team and it was concluded that the resting and post exercise systolic blood pressure measurements decreased significantly after sixteen weeks while the pulse rate had changes indicated conditioning and changed in six weeks. During detraining these measurements were reverse and made significant changes in ten weeks.

1.3.3. MEAN ARTERIAL BLOOD PRESSURE AND INTERVAL TRAINING

Berne and Levy explain that the mean arterial pressure is the pressure in the arteries averaged over time. It may be obtained from an arterial pressure tracing by measuring the area under the curve and dividing this area by the time interval involved. The mean arterial pressure $P_a$, usually can be approximated satisfactorily from the

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measured values of the systolic $P_s$ and diastolic $P_d$ pressure by means of the following formula:

$$P_a = P_d + \frac{1}{3} (P_s - P_d)$$

The mean pressure will be considered to depend only on the mean volume of blood in the arterial system and the elastic properties of the arterial walls. The arterial volume $V_a$, in turn depends on the rate of inflow, from the heart into the arteries (cardiac output) and the rate of outflow $Q_o$ from the arteries through the capillaries (Peripheral run off).

If arterial inflow exceeds outflow, then arterial volume increases and the arterial walls are stretched more and pressure raises. The converse happens when arterial outflow exceeds inflow. When inflow equals outflow, arterial pressure remains constant.

1.3.4. INTERVAL TRAINING AND ANAEROBIC POWER

Leg power is characterized by the explosive movement of the entire body. Leg power or anaerobic power is the power generated by the legs when moving the body. As body weight is the mass moved, the mass varies among subjects.

Due to intensive interval training, the anaerobic power of an athlete is increased. [It has been observed that there is a 25% increase in ATP CP stores form owing to anaerobic training.] Interval training increases the aerobic enzyme that is phosphofructokinase and lactodehydrogenase and the glycolyte capacity of the muscle is increased about two fold.
The effect of anaerobic training has been observed that there is a 25% increase in ATP stores owing to the training. Sprint type interval training increases the anaerobic enzyme i.e., phosphofructokinase and lactate dehydrogenase.

Peak lactate concentration increases with training. The glycotic capacity of the muscle is increased about two fold.¹¹

1.3.5. CARDIORESPIRATORY ENDURANCE AND INTERVAL TRAINING

Cardiorespiratory endurance is the ability to sustain physical exercise and to recover from vigorous physical activity in a responsible time with no lasting side effects. It is concerned with the aerobic efficiency of the body, which is the ability of the body to supply fuel and oxygen to the muscles being used. The heart’s capacity for pumping blood is a major factor in cardiorespiratory endurance. A conditioned heart is able to exert greater force with each heart beat, and as a result a greater volume of blood is released into arteries to be carried through the body.¹²

Cardiorespiratory endurance has become synonymous with the term physical fitness. A minimal level of cardiorespiratory endurance is essential for any sport or activity, and the current opinion is that higher levels can improve the quality of the athletes’ performance. Cardiorespiratory endurance, in contrast to muscular endurance, is possibly the most important component of general physical fitness.


Training results in a number of changes that improve the transportation function of the Cardiovascular and respiratory systems during exercise. The heart rate at rest will decrease markedly as a result of endurance conditioning. Initial heart rate is 80 beats per minute, and the resting heart rate will decrease by approximately one beat per minute for each week of training during the first few weeks. Following ten weeks of modest endurance training, the resting rate should drop to 70 beats per minute. Highly conditioned endurance athletes typically have resting heart rates of 40 beats per minute or lower.\(^{13}\)

The terms Cardiorespiratory endurance, Cardiovascular endurance, or aerobic endurance all refer to the same thing: Persistence in continuing an activity. This ability differs from the endurance function of muscle (repeating or sustaining a contraction). Cardiorespiratory endurance refers to the ability to transport it to the tissues of the body. Obviously, muscle endurance depends upon Cardiorespiratory fitness, for without it sufficient oxygen would not reach working muscles.\(^{14}\)

The term Cardiorespiratory suggests a relationship between our lungs, heart and blood vessels. Essentially the affiliation is as follows: Environmental air is breathed into the body and enters the lungs, oxygen then diffuses from this volume of air into the tiny, thin-walled blood capillaries. Surrounding small air sacs (alvelli)
in the lungs. Capillaries ultimately connect with arteries, which deliver oxygen and nutrients to our body's cells.¹⁵

1.4 BLOOD GLUCOSE AND INTERVAL TRAINING

Ramakrishnan¹⁶ states that physical exercise could increase blood flow in trained subjects and improve the microcirculation. There will be increased peripheral blood flow which brings greater amount of glucose to the site of utilisation. Such increased utilisation of glucose may bring about desirable decrease in blood sugar. In the fasting state, mild exercise leads to hyperglycemia excess of sugar in blood due to Glycogenolysis. But severe exercise leads to lypocemias. In addition, if the respiratory quotient is about 0.75 in the fasting state, there is a possibility of developing ketosis. Even with adequate diet, if the duration of exercise is very long as in marathon race, it can lead to hypoglycemia. The practice of taking glucose during exercise is aimed more at preventing hypoglycemia than giving energy for the exercise. Dietary glucose also spares the fatty consumption. It is not clear whether the free fatty acids directly metabolized in muscle are required to be converted to glucose.

1.4.1 BLOOD LACTIC ACID AND INTERVAL TRAINING

The elevation in blood and muscle lactate concentration in response to exercise is one of the oldest observations of the biochemical events of muscular activity. Over the years controversy has ranged and continues to exist concerning the reasons for this rise in lactate, its consequence to exercise, how it is influenced by training,

¹⁵ Ibid, P.189.
and diet on the concentrations of lactate in muscle and blood. This is followed by consideration of the biochemical events in muscle including the relationships between oxygen supply and production as elevated during exercise. The factors relating to mechanism for the increase of lactate in blood during exercise is continued with a presentation that relates these factors to humans during exercise. Finally, the fact of lactate as a fuel for direct oxidation during and after exercise is elevated from students who have used radio-activity tracers both with animals and humanbeings as subject.17

1.5 INTENSITY

Intensity has been called the most important of the prescriptive components. It is also the most difficult because of the necessity to bring it under control, that is, intensity is expressed in terms that they are stable such as heart rate. So attention must be made to conditions that create stability and the methods that monitor change.

Different activities can be carried out with different intensities which may have different effects on organisms. According to Nobble18 exercise intensity is determined by adding four seconds to the average race pace. This is maximal time manipulation of exercise and rest time has a sufficient effect on the intensity of the training stimulus.

The proper intensity of training can be determined by simple trial and error. If an exercise bout results in a heart rate, that is below the training heart rate, increase the speed or intensity of the next bout; if the heart rate is above the training heart


rate, decrease the intensity of the next bout. One of the great advantages of this type of programme is that it allows exercise in many varied and different conditions with minimal danger. The heart rate will accurately reflect the stress level on the body and allow an adult to exercise safely or the activity may decrease but the training effect will be safe. This principle works in an other way too. As the cardiovascular system becomes more efficient work will become easier and the tempo of the activity will necessarily increase to maintain the training heart rate. Training by heart has many advantages over training by time and distance.¹⁹

1.5.1 Intensity of Training

Intensity yields greater improvement in performance. The first untrained man achieves basal output with a resting rate of 60 per minute and is capable of working hard enough to reach 160 per minute, which together with his stroke volume increases his output, to 2.75 x cc/minute. The second trained man achieves basal output and achieves a maximum of 200 per minute similarly increasing cardiac output to 6.5 cc/minute.²⁰

Most exercise physiologists agree that the physiological and biochemical changes associated with training occur about 70 percent of the individual’s maximal aerobic capacity, where as intensity less than 60 percent are not nearly sufficient.


The same experts have also warned adults exceeding 90 percent of their maximal aerobic capacity even during peak exercise effort. They recommend that most adults work at an intensity some what between 60 percent and 80 percent of their maximal capacity for safe effective training. These levels can be estimated by using heart rate as a guideline.21

1.6 DETRAINING

Physical detraining has been investigated through two major approaches by observing changes following total bed rest for extended periods of time and by observing changes in trained individuals as they cease formal physical training and become physically inactive. The results of these various studies will be discussed individually, according to the specific components of physical training.22

Hickson23 et. al. found that, once the desired level of aerobic training had been reached, the frequency or the duration of training session could be reduced by as much as two thirds without any adverse effect on physical condition. But if subjects decreased the intensity of training sessions, there was a substantial loss of aerobic power over the first 15 weeks of observation. Similarly, gains in strength could be sustained by one session of isokinetic exercise a week, provided that the intensity of contractions was not reduced.


1.6.1. OBJECTIVES OF THE STUDY

Interval Training is a series of repeated bouts of exercises alternated with periods of relief. It allows to perform more work at an intense work load, over a long period of time than working continuously. It helps to prepare sports man for better performance. Interval Training can be performed without any instruments. It requires very limited space. The Interval Training should be based on individual specific needs Goals and physical capabilities.

Though there are number of research have been completed in this area by the researchers from various countries, no research has been undertaken with the varied intensities of interval training in Tamilnadu State College men players. Further the intensities prescribed by the other authors from abroad may not be suitable to the Indian conditions. Hence the investigator has selected this study for his research.

1.7 STATEMENT OF THE PROBLEM

The purpose of this study was to find out the effects of the varied intensities of Interval Training on Resting pulse rate, Mean Arterial Blood Pressure, Anaerobic Power, Cardio respiratory endurance, Blood lactic acid and Blood Glucose levels of male students in colleges.

The Second purpose of the study was to find out the effects of Detraining on
varied intensities of Interval training on Resting Pulse rate, Mean Arterial Blood Pressure, Anaerobic power, Cardiorespiratory endurance, Blood Lactic acid and Blood Glucose of male students of colleges.

The third purpose of this study was to find out the periodical effects of the varied intensities of Interval Training on Resting pulse rate, Mean Arterial Blood Pressure, Anaerobic power, Cardiorespiratory endurance Blood lactic acid and Blood Glucose levels of male students in colleges.

1.8 HYPOTHESIS

1) It was hypothesised that there would be statistically significant effects of varied intensities of interval training on Resting Pulse rate, Mean Arterial Blood Pressure, Blood Lactic Acid and Blood Glucose levels.

2) It was also hypothesised that there would be statistically significant effect of detraining on Resting pulse rate, mean arterial blood pressure, Anaerobic power, cardio respiratory endurance Blood lactic acid and Blood glucose.

3) It was also hypothesised that the Intensive Interval training group may be better than Extensive Interval training Group on Resting Pulse rate, Mean Arterial Blood Pressure, Anaerobic Power, Cardiorespiratory endurance, Blood Lactic acid and Blood Glucose.
4) Hypothesis IV stated that there would be statistically significant reduction after one month of Intensive interval detraining on Resting Pulse rate, Mean Arterial Blood Pressure, Anaerobic Power, Cardiorespiratory endurance, Blood Lactic acid and Blood Glucose.

5) Hypothesis V stated that there would be statistically significant reduction after one month of Extensive interval detraining on Resting Pulse rate, Mean Arterial Blood Pressure, Anaerobic Power, Cardiorespiratory endurance, Blood Lactic acid and Blood Glucose.

1.9 SIGNIFICANCE OF THE PROBLEM

The present study may be considered significant because of the following likely benefits. This study provides an opportunity to find out the effect of varied intensities of interval training for the promotion of effective sports training programmes. The findings of the study may help to frame suitable training work schedules.

The findings of the study may help the coaches and physical education teachers to find out the effects of varied intensities of interval training during varied weeks.

The findings of the study may help the coaches and physical education teachers to find out in which period sportsmen lose their performance levels and also help them to find out their decrease every week.
1.10 DELIMITATIONS

The study was delimited to ninety male students aged between 17-20 years of The Madura Diraviyam Thayumanavar Hindu College, Tirunelveli.

The extensive interval training and intensive interval training were only considered as varied intensities of interval training.

The extensive interval training method was limited to 60 to 80 percent intensity. But the intensive interval training was limited to 80 to 90 percent intensity.

The study was restricted to the following variables viz, Resting pulse rate, mean arterial blood pressure, Anaerobic power cardiorespiratory endurance, Blood Lactic acid and Blood Glucose.

1.11 LIMITATIONS

This research study was limited in the following respects and limitations should be taken into consideration while interpreting the results.

Certain factors like habits, life style, daily routine and diet which may have an effect on the results of the study were not taken into consideration.
No attempt has been made to control the factors like air resistance, intensity of light atmosphere and temperature.

No special motivational technique was used during testing. Therefore the difference that occurred in performance due to lack of motivation may be recognised as a limitation for the study.

The status of the subjects belonging to different economic and educational backgrounds which affected their performance was not taken into consideration.

1.12 DEFINITION AND EXPLANATION OF TERMS

1.12.1 Interval training

Interval training, as the name implies, is a series of repeated bouts of exercise alternated with periods of relief. Light or mild exercise alternated with periods of relief.25

1.12.2 Intensity

Intensity is the rate of doing work. In other words it is the pace at which physical activity is done.26


12.3 Extensive Interval Training

Extensive interval training is a method of endurance training which involves repetitions of loads of medium intensity (60% to 70% of the maximum speed); the intensity being medium and number of repetitions performed being more.27

1.12.4 Intensive Interval Training

It is a method of endurance training which involves repetitions of loads of submaximal intensity- (80 to 90 percent of the maximum speed); the intensity being high, lesser number of repetitions are performed.28

1.12.5 Detraining

Detraining may be defined as the temporary or permanent reduction or withdrawal of a training stimulus which may result in the loss of anatomical and physiological adaptations as well as decrease in athletic performance.29

1.12.6 Resting Pulse Rate

Pulse rate is actually the frequency of pressure waves (waves per minute) propagated along the peripheral arteries such as carotid or radial arteries.30

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1.12.7 Mean Arterial Pressure

The average of the systemic systolic and diastolic pressures during a complete cardiac cycle (systolic plus diastolic) is called the mean arterial Pressure.\textsuperscript{31}

1.12.8 Systolic Pressure

The highest level to which the arterial blood pressure rises following the systolic rejection of blood from the left ventricle.\textsuperscript{32}

1.12.9 Diastolic Pressure

The lowest level in which the arterial blood pressure falls in the interval between successive heart beats.\textsuperscript{33}

1.12.10 Anaerobic Power

Anaerobic power is defined as the peak power output attained in a short duration test of usually less than or equal to thirty seconds.\textsuperscript{34}


\textsuperscript{34} Jack H. Wilmore and David L. Costill, \textit{Op.cit.}, P.175.
1.12.11 Cardiorespiratory Endurance

Cardiorespiratory endurance is defined as the ability of the total body to sustain prolonged, rhythmical exercise.35

1.12.12 Blood Glucose

Blood Glucose refers to the blood sugar circulating in the blood at a constant level and it is used by the muscles during the activity.36

1.12.13 Blood Lactic Acid

A fatiguing metabolic of the lactic acid system resulting from the incomplete breakdown of glucose (sugar).37

35 Ibid., P.175