INTRODUCTION
CHAPTER I

INTRODUCTION

Today's technological generation relies more on sports as it provides relaxation to everybody who practice it daily. Regular practice of sports reduces lifestyle diseases and physiologically improves the overall fitness level and performance. At present, there are varieties of training in sports field for enhancing the performance and bringing a person into high level of fitness without any addition of ergogenic aid. Seldom do sports persons think regarding the changes taking place in their body through training. They think only of the performance. This study will give detailed information about the effects of training and biochemical changes in blood and haematological changes. The study has its contributions from both physical education and medical field. This introductory chapter consists of sections with Description of Trainings, Statement of Problem, Hypothesis, Delimitations, Limitations, Terms and Definitions, Significance of Study.

The detail of sports is provided first in this chapter as it is purely related to sports and fitness. A sport is commonly defined as an organized, competitive, and skillful physical activity requiring commitment and fair play. It is governed by a set of rules or customs. In a sport, the key factors are the physical capabilities and skills of the competitor while determining the outcome (winning or losing). The physical activity involves the movement of people or a variety of objects such as balls and machines. In contrast, games such as card games and board games, though these could be called mind sports, require only mental skills. Non-competitive activities such as jogging and rock-climbing are usually classified as recreations. Finally, major games such as soccer, basketball, and volleyball are classified.

Any physical activity leads to anatomical, physiological and biochemical changes. The efficiency of a physical activity results from its duration, distance, and repetitions (volume), load and velocity (intensity) and the frequency of performance (density). When planning the dynamics of training, we need to consider these aspects, which are usually referred to as the variables of training.
Sports\(^1\) has been increasingly organized and regulated from the time of the ancient Olympics to the present. Industrialization has brought increased leisure time to the citizens of developed and developing countries, leading to more time for citizens to attend and follow spectator sports, greater participation in athletic activities, and increased accessibility. These trends continued with the advent of mass media and global communication. Professionalism became prevalent, further adding to the increase in sport's popularity, as sports fans began following the exploits of professional athletes through radio, television, and the internet, all while enjoying the exercise and competition associated with amateur participation in sports.

In the new millennium, sports advances further from the physical aspects to the mental or psychological aspects of competition. This transition occurs due to scientific adaptation and technological intervention in sports to achieve good performance and bring the fitness level among the athlete and normal people. Activities were the outcome is determined by judgment over execution are considered performances, or competition.

This study concentrates specifically on blood parameters, i.e., blood biochemical and haematological changes. The normal rate of blood biochemical parameters may differ in individuals. In case of normal people, sports persons and patients, normal value will change. In case of sports persons, blood parameters will differ before and after training. The duration of a single session of training, whether long or small, could be the reason for the changes in the normal value of blood parameters in them.

Blood has an important function to play in human life that includes the energy supply to all part of body, and the cells that exists in the body. Human beings can’t survive without blood. So, blood could be considered as having high value for all living things including human beings. Blood is a complex body fluid that has multiple roles to play within our body.

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Sports training have its own value in the present society. Many of the hypokinetic diseases can be controlled through regular physical fitness activities and sports training. There are lots of changes taking place in a human body through physical activity, some of them are muscular strength, speed, reaction ability, agility, cardiac efficiency and so on. These physical components increase considerably through physical activity and cholesterol, blood pressure and glucose level will decrease. So doctors are referring to their patients to go for physical training like moderate jogging and walking. I would like to assert at this juncture that physical training will improve the fitness level of a person either non-athlete or athlete after specific duration of training. In case of athletes, training improves their performance. Athletes are never conscious of the changes taking place in their body, they are always bothered about the improvement of performance and competition. P J Mehta\(^3\) mentions in his book Practical Medicine that, regular exercises will decrease the blood pressure, so regular exercise is beneficial for everyone.

The health of an individual depends on many factors including body type, heredity, and attitude of living, the level and intensity of training etc. Nowadays, athletes and non-athletes are very much bothered about their health and fitness as once their fitness is lost, then it is very difficult to get back to the previous condition. Likewise, if they are getting an injury it will take long time for recovery and rehabilitation which will again consume time to bring back their fitness level. Apart from these types of injury and decrease in fitness, if the athlete is suffering from fever and some other diseases it would bring down the fitness levels. In such conditions, if the health gets weaker it is medically possible to analyse and detect the type of diseases and injury that has happened to an athlete through blood check up.

Health\(^3\) of an individual depends on the harmonious equilibrium of all the biochemical reactions occurring in the body, while disease condition reflects the abnormalities in the normal biochemical reaction in body. Physical fitness\(^4\) comprises two related concepts, general fitness (a state of health and well-being) and specific fitness (a

\(^{3}\text{Mehta, P J Practical Medicine, (16th ed.) Mumbai, National Book Depot, 2003, 43 Print}\\
^{3}\text{Beedu Sashudar Rao and Vijay Deshpande, Experimental Biochemistry a Student Companion New Delhi, I K International Pvt Ltd, 2005, 191 Print}\\
^{4}\text{Brandon, Leigh Anatomy of Strength and Fitness Training for Speed, London McGraw-Hill 2009, Print}
task-oriented definition based on the ability to perform specific aspects of sports or occupation) Physical fitness is generally achieved through exercise, correct nutrition and enough rest. It is an important part of life. In the earlier days, fitness was commonly defined as the capacity to carry out the day's activities without undue fatigue. However, as automation increased, leisure time and changes in lifestyles following the industrial revolution rendered this definition insufficient. These days, physical fitness is considered a measure of the body's ability to function efficiently and effectively in work and leisure activities, to be healthy, to resist hypokinetic diseases, and to meet emergency situations and improve the fitness level and performance.

Due to sports training, many changes take place physiologically and psychologically. Physiologically, the main change occurs in motivation. That is, willingness to carry through a long and arduous training programme, a desire to excel in competition, a preparedness to sacrifice safely to speed, a determination to persist with physical effort in the face of discouragement and physical discomfort and a subordinate of personal glory to group objecting coupled with a preparedness to face and match the aggression of an opposing team.

The blood transport of oxygen depends on the maximum cardiac output, the oxygen transporting properties of the blood, and the maximum arterio-venous oxygen difference. The effectiveness of a given cardiac output is also influenced by its relative distribution between the active muscles, skin and viscera. The maximum stroke volume depends upon body posture and the type of exercise performed. A cardiac output of 30 to 35 liter/minute is equivalent to a stroke volume of 150 to 180 ml and it is common in endurance athletes.

Some understanding of the biochemistry of exercise is fundamental to any study of the factors that contribute to sports performance. It is the physical, chemical and biochemical properties of cells and tissues that determine the physiological responses to

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exercise, and yet the teaching of exercise biochemistry is poorly developed compared with exercise physiology

1.1 DESCRIPTION OF TRAINING

In the present study there are three different types of training selected, they are given below

- Circuit Training
- Weight Training
- Interval Training

Circuit Training gained popularity as strength training machines, such as Universal, Nautilus, Marcy and Pyramid became commonplace in the 1970's. Eight to twelve exercise stations are chosen and the athlete performs the exercise in a circuit (one after the other), then repeats the circuit one to three times. Circuit training aims to address cardiovascular endurance as well as local muscular endurance. It also promotes some moderate strength gains. Circuit training is a combination of high-intensity aerobics and resistance training designed to be easy to follow and target fat loss, muscle building and heart-lung fitness. An exercise "circuit" is one completion of all prescribed exercises in the program.

Circuit training is a workout routine that combines cardiovascular fitness and resistance training. It was first proposed in the late 1950's as a method to develop general fitness. The initial routines were arranged in a circle, alternating between different muscle groups (hence the name circuit training). By allowing only a short rest interval of 30-90 seconds between stations, cardiovascular fitness is gained along with the benefits of resistance training.

One more description for the circuit training is, a circuit of exercises is regarded as the best way for keeping children fit. Anything can be included in the circuit including press-ups, sit-ups and shuttle runs. In this training, athlete should move quickly from one exercise apparatus to another and doing a prescribed number of exercises or time on each apparatus, keeps pulse rate high and promote overall fitness, by generally working all

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8 Lee E Brown Strength Training, Champaign, USA Human Kinetics 2007, 59 Print
muscle groups as well as heart and lungs. Circuit training is an excellent way to improve mobility, strength and stamina. The circuit training format utilizes a group of 6 to 10 strength exercises that are completed one exercise after another. Each exercise is performed for a specified number of repetitions or for a prescribed time before moving on to the next exercise. The exercises within each circuit are separated by brief, timed rest intervals, and each circuit is separated by a longer rest period. The total number of circuits performed during a training session may vary from two to six depending on your training level (beginner, intermediate, or advanced), your period of training (preparation or competition) and your training objective. An example of circuit training format is given below.

**Figure 1**

![Diagram of circuit training format](image)

Note: Sample of circuit training. This is not applied for the athletes for studies.

The advantages of circuit training are:

- Develops strength and endurance
- Circuits can be performed to improve cardio-vascular endurance
- Flexibility, agility or a combination of fitness related benefits
- Appropriate form of training for most sports
- Can be adjusted to suit age, fitness and health of the athlete
- Exercises are simple enough to make each athlete feel a sense of achievement in completing them
- A wide range of exercises to select from which will maintain the athlete's enthusiasm

Disadvantages of circuit training are

- Many exercises require specialized equipment - e.g. gym equipment
- Ample space required to set up the circuit exercises & equipment
- In general can only be conducted where appropriate facilities/equipment are available
- Use of additional equipment requires appropriate health and safety monitoring

Definition for Weight training, it is a common type of strength training for developing the strength and size of skeletal muscles. It is a form of physical exercise using weights to increase the strength and size of muscles by using exercises specific for each muscle group. Weight lifting, power lifting and body building are not the same as weight training. Weight lifting and body building focus on lifting very heavy weights. Weight training for the fitness purpose focuses on using lighter weights to strengthen muscles, improves performance and prevents injury. Weight training can do a lot of other good things for everybody's body. If anybody wants to become an athlete, weight training will help them to perform better in all types of sports. Some studies show that weight training may reduces levels of unhealthy cholesterol in the blood. The body needs some cholesterol. However, too much of this waxy substance can lead to heart diseases. Weight training can maintain or increase bone density. This means that bones remain strong. With dense, healthy bones, you're less likely to suffer a bone fracture or crack. It is important to know that without exercise, our bones lose density as we age. Weight training also reduces the risk of osteoporosis, a condition in which bones become fragile.

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Resistance training will increase the muscle size (hypertrophy). Muscle growth depends on the muscle fibre type activated and the pattern of recruitment. Muscle growth is due to one or more of the following adaptations:

- Increased contractile proteins (actin & myosin)
- Increased number of and size of myofibrils per muscle fibre
- Increased amounts of connective, tendinous and ligamentous tissues
- Increased enzymes and stored nutrients

Weight Training can be traced back to the beginning of recorded time, as early as 2000 B.C., the ancient Egyptians lifted sacks of sand to strength training for hunting and military duty. According to military records, the Chinese also used strength training for their military personnel as early as 700 B.C. But the historical association that most people are familiar with is that of the ancient Greeks. Many of the athletes who competed in the ancient Olympics lifted heavy stones to develop strength and boost their athletic performance. Besides those functional results, strength training provided the development of a muscular physique. Several famous athletes during the ancient periods such as Milo and Hercules often performed feats of strength and displayed their muscularity to spectators who gathered to watch it. In the 19th century, the appreciation by the masses for heavy muscled physiques made celebrities out of many performing strongman of that time. The most famous was Eugen Sandow, who is considered as the father of Bodybuilding.

There are many benefits of weight training. It is also known as resistance training. These include stronger bones, enhanced strength, muscular endurance and improved athletic ability. There are many wrong concepts seen common among the public. Even some athletes have misconceptions regarding lifting weight for the performance especially of risks and benefits of weight training. The main wrong concept is that weight training will become an obstacle for improving height in athletes. They become concerned about potential damage to bone growth due to this. Sadly, the misconception stems from a myth that resistance training in children will lead to the premature closure of the end plates of...
long bones, thereby arresting their growth. In reality, any damage to these growth plates is usually a result of fractures that occur from repeated maximal lifts, lack of adult supervision, and improper lifting techniques. Overall, the risk of injury in children who train with weights is actually quite low, as long as appropriate training guidelines are followed. I would suggest that if training is attained from a trained coach then there remain fewer chances to get injury and the coach would be able to instruct the trainee regarding the benefits of weight training.

Interval training is defined as a training session that involves repeated bouts of exercise, separated by rest intervals. Deliberately alternating between brief periods of lower and higher intensity levels during a workout, a method used to maximize cardiovascular endurance. Interval training is a type of physical training that involves bursts of high intensity work. This high intensity work is alternated with periods of rest or low activity, the eponymous intervals. The term can refer to any cardiovascular workout (e.g., cycling, running, rowing, etc.) that involves brief bouts at near-maximum exertion interspersed with periods of lower-intensity activity. Interval training is often practiced by long distance runners (800 mts and above). Sprinters and footballers have also been known to use this type of training.

Interval training is the performance of an aerobic activity done at high intensities for brief periods of time. The energy system used by a body may be aerobic or anaerobic, depending on how intense the exercise is. The goal of interval training is to increase one’s ability to do short spurts of high intensity aerobic activity and to improve aerobic fitness. There are varieties of interval training techniques and depending on the activities we can choose the training technique. Due to interval training risks, many people never undergo high-intensity activity spurts and may prefer not to do interval training because of the injury risks or as they are content with their fitness level. While designing training, it should include interval training 2 times a week. The goal for each interval is to work out at an intensity of 80-100% Max HR, depending on where your lactate threshold is. 

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training or speed training is an example for interval training. Distance runners often practice interval training on tracks, running hard at a certain pace for a specified distance (or, less often, time) and jogging, walking, or resting for a set distance or time before the next speed burst. Distances can also vary, one example would be a "ladder" workout consisting of a 1600-meter, two 1200-meter, three 800-meter, and four 400-meter repetitions, each at an appropriate speed and with an appropriate amount of recovery.

Interval training (long, medium, short distance or time) is a highly taxing type of training. The term interval training does not necessarily refer to a well-known method but to all methods performed with a rest interval. There are some other sub types in interval training and they are:

Repetition Method: The repetition method is of distance longer or shorter than the racing endurance. Longer repetitions place a strong demand on the aerobic component of racing endurance, as the performance speed is close to the racing speed. On the other hand, shorter repetitions solicit the anaerobic component, as the performer often develops an oxygen debt. Obviously, in the latter case, the intensity is slightly higher than that of a race. An important asset of repetition method is developing will power through the demand to perform many repetitions. The total volume of work may be four to eight times that of the racing distance, with a rest interval between 5 to 10 minutes, depending on the repetition distance and intensity.

Model Training: This method most resembles the specifics of a race, hence the name. The first part of training consists of many repetitions that are shorter than the race distance, performed at intensity close to racing intensity. The mid part of the training uses distances and intensity that improve and perfect the aerobic endurance. The last part employs short distance repetitions to exactly model the race, which resemble and develop the final lick capacity. The main elements of progression are intensity and duration of stimuli, the number of repetitions, rest interval, and activity during rest.

Short Distance Interval Training: between 15 seconds and 2 minutes, mostly develops anaerobic endurance.
Medium Distance Interval Training, 2 to 8 minutes develop both energy production systems.

Long Distance Interval Training 8 to 15 minutes, has a main training effect of aerobic endurance improvement.

Interval training is a maximum cardiovascular exercise. All cardio benefits are ramped-up by doing interval training once a week. The benefits are huge and heart rate slows and uses oxygen more efficiently and faster. There are some hormonal changes taking place and it is proved scientifically. An example is the endorphins (group of peptide hormones that bind to opiate receptors and are found mainly in the brain. Endorphins reduce the sensation of pain and affect emotions) supply around in bloodstream very fast. Interval training which will commonly affect athlete were endorphin production is ramped to the maximum. These naturally occurring opiates are produced in brain in response to strenuous exercise. Interval training - due to its short bursts of intense activity - really gets the endorphins flowing, and feels fantastic. Resting pulse drops like a stone. When doing consistent interval training, resting pulse is 46 to 48. Resting pulse is a good measure of stroke volume - the amount of blood the heart pumps on each beat. The more blood pumped per beat the less heart needs to beat each minute. Cardiovascular exercise over time increases your stroke volume. Interval training is maximum in cardiovascular exercise and leads very quickly to increased stroke volume. Heart rapidly increases its efficiency with consistent interval training and total lifetime fitness levels increase accordingly. It will further save wear and tear in heart. As interval training increases heart's stroke volume, heart beats less during the course of the day to provide the amount of blood that one need flowing to the tissues. Less heart beat means less wear and tear. The hypothetical extrapolation is that heart will last longer because people are doing intense vigorous exercise and it is pretty remarkable and leads to decreased risk of high blood pressure.

Cardiovascular exercise has abundant medical benefits, including decreased susceptibility to heart disease. Interval training, being the most intense form of cardio exercise, offers even greater benefits over time. A lowered cholesterol level is an important benefit. Again, cardiovascular exercise is consistently been shown to reduce blood cholesterol. Lower cholesterol has many medical benefits, including lowered risk of heart
disease, arthritis, and other inflammatory disorders. It strengthens the immune system. A person’s immune system responds positively to regular strenuous exercise. Interval training - due to its intense qualities - yields a heightened immune response. People who exercise regularly build-up a "shield" against cold and flu, and East Coasters often go through an entire winter without "getting sick." In some research papers it is mentioned that people look younger if they are engaging with physical training. The benefits of exercise are profound and influence both physical and personal aspects of a person’s life. An athlete can sleep better if he/she is doing heavy physical training and while waking up athletes feels more refreshed. Skin will glow as the training athlete will sweat, so the skin will often keep refreshed. Digestion improves due to sports training. Altogether, everybody can stay healthy and well if they maintain proper level of specific fitness training. Attitude of the individual throughout the day becomes consistently positive. A study by Gibala et al., demonstrated that 2.5 hours of sprint interval training produced similar biochemical muscle changes to 10.5 hours of endurance training and similar endurance performance benefits.

1.2. STATEMENT OF PROBLEM

The statement of problem of this study is effect of different training methods on selected biochemical parameter in age group between 16 to 18 years athletes. This study is a combination of sports fitness and medical field. The study would give the information of blood biochemical variable changes in normal values takes place after sports activity.

1.3 SIGNIFICANCE OF STUDY

This study will give information regarding the biochemical changes taking place in human body due to sports or fitness training and it will give the details of how the biochemical changes enhance the fitness of athletes. The study will relieve the basic normal level of particular blood parameter which could be better for the sports training. The study will generate awareness of blood parameters to the athletes, coaches and physical education teachers and it also give an idea to improve the fitness level in both athlete and non-athletes based on blood parameter. The information about the selected blood parameters will give a brief idea on the lifestyle diseases to the public and the athlete. Based on this study, physical fitness training program can be conducted for normal people with sedentary
habits, other than athletes. The study intends to reveal that better training could bring in alteration of blood biochemical particle that would affect the performance of an athlete.

1.4 HYPOTHESIS

It was hypothesized that there may be changes taking place in almost all blood parameters in a human body after the sports training. It was hypothesized that circuit training is most advantageous for altering the blood parameter from normal values in athletes. It was further hypothesized that there may be less alteration on serum bilirubin after specific training.

1.5 DELIMITATIONS
- The study is delimited to selected sports training like Circuit Training, Interval Training and Weight Training.
- The study is delimited to male athletes only.
- The timing of blood sample collection is between 6:00 AM to 9:00 AM only.
- The study is delimited to the athletes from Mangalore and Udupi.
- The study is delimited only to the pre-university level athletes.
- The study is limited to the athletes and they should have minimum participated in state level or in reputed sports meet.

1.6 LIMITATIONS
- The study is limited to the factors like heredity.
- The study is limited to the area of living.
- The study is limited to the diet for long days.
- The study is limited neither medicines nor herbs.
- Body type and anthropometric measurement is not considered.
- The study is limited only to the selected blood parameters.
1.7 TERMS AND DEFINITIONS

There are various components in blood. All have specific functions to sustain a human life.

Blood\textsuperscript{12}: The familiar red fluid in the body that contains white and red blood cells, platelets, proteins, and other elements. The blood is transported throughout the body by the circulatory system. Blood functions in two directions: arterial and venous. Arterial blood is the means by which oxygen and nutrients are transported to tissues while venous blood is the means by which carbon dioxide and metabolic by-products are transported to the lungs and kidneys, respectively, for removal from the body. The Blood\textsuperscript{13} is a life-sustaining fluid which circulates through the heart and blood vessels. It carries oxygen and nutrients to the tissues and waste products to the lungs, liver, and kidneys, where they can be removed from the body. Hemoglobin\textsuperscript{14} is a plasma protein that is exclusively produced in erythroid precursor cells. Hemoglobin comprises approximately 95% of the total proteins in mature red blood cells. Hemoglobin is responsible for the oxygen transport in blood and its delivery to the tissues, as it carries most of the oxygen in the blood. Hemoglobin can bind oxygen and/or carbon dioxide, the amount of oxygen bound to hemoglobin is determined by the oxygen concentration, carbon dioxide concentration, and pH. Normally, hemoglobin works like this:

- Hemoglobin in red blood cells entering the lungs has carbon dioxide bound to it.
- In the lungs, oxygen concentration is high and carbon dioxide concentration is low due to breathing.
- Hemoglobin binds oxygen and releases carbon dioxide.
- Hemoglobin gets transported through the heart and blood vessels to the muscle.
- In muscle, the carbon dioxide concentration is high and the oxygen concentration is low due to metabolism.

\textsuperscript{13}Barbara J Bam, A Beginners Guide to Blood Cells 2\textsuperscript{nd} Ed. Massachusetts Blackwell Publishing 2005, 1 Print.
Hemoglobin releases oxygen and binds carbon dioxide. Hemoglobin gets transported back to the lungs and the cycle repeats.

Red Blood Cells are the blood cells that carry oxygen. Red cells contain hemoglobin, and it is the hemoglobin which permits them to transport oxygen (and carbon dioxide). Hemoglobin, aside from being a transport molecule, is a pigment. It gives the cells their red color (and their name). The abbreviation for red blood cells is RBCs. Red blood cells are sometime simply called red cells. They are also called erythrocytes or, rarely today, red blood corpuscles.

Biochemical or Biochemistry is the application of the tools and concepts of chemistry to living systems. In other words, we can say that the study of the chemical substances and vital processes occurring in living organisms, biological chemistry, physiological chemistry. Biochemistry can be defined as "the science concerned with the chemical basis of life." The term biochemistry was coined by Newberg in 1903. It deals with the structure, properties, and chemical reactions of various biomolecules that are present in the living system.

Packed cells are carrying hemoglobin thereby help in the transport of oxygen and carbon dioxide to and from the cells respectively. The life time of a unit of packed cells is 20-40 days depending on the preserving conditions. The erythrocytes of red blood cell is unique in that, unlike all other cells of the body, it is devoid of a nucleus of DNA, RNA and Intracellular Organelles of a cytochrome system and of the capacity for oxidative phosphorylation. The major task of the erythrocyte is transport of hemoglobin, is

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16Prasad R M The Book of Biochemistry and Nutrition for B Sc Nursing, Mangalore R M Publication 2008, 8 Pnt
18EncD Wills Biochemical Basis of Medicine, Bristol John Wright and Sons Ltd 1985, 308 Pnt
performed with neither expenditure nor gain of energy. Platelets\textsuperscript{19}: These are the cells responsible for the clotting of blood. If the count of platelet in blood is less, it means it will cause death. Platelets are made by bone marrows in the body. It is also known as Thrombocytes. Blood platelets are small cells about 1/3rd the size of a red blood cell. They are spherical or oval non-nucleated discs, numbering about 2, 50,000 per cubic mm.

White blood cells or Leukocytes\textsuperscript{20} refers to a blood cell that does not contain hemoglobin. White blood cells are made by bone marrow and are specialized to defend the body against harmful bacteria and other micro-organisms. There are two main types of leukocytes, and they are Granular or Agianular. Both these types are manufactured in the red bone marrow.

Proteins\textsuperscript{21} are defined as the high molecular weight mixed polymers of amino acids joined together with peptide linkage (\(-\text{C}0-\text{N}H-\)) Proteins are the chief constituents of all living matter. They contain Carbon, Hydrogen, Nitrogen, Sulphur and Phosphorous. Protein is having biological importance, they are the essence of life process. Proteins are the fundamental constituents of all protoplasm and are involved in the structure of the living cell and in its function. Many of the hormones are proteins. Proteins act as the defenders against infections by means of the antibodies.

Lipid profiles\textsuperscript{22} is a group of tests that are often ordered together to determine risk of coronary heart disease. They are tests that have been shown to be good indicators of whether someone is likely to have a heart attack or stroke caused by blockage of blood vessels or hardening of the arteries (atherosclerosis). The lipid profile typically includes:

\begin{itemize}
  \item Cholesterol
  \item Triglycerides
  \item High-density lipoprotein (HDL)
  \item Low-density lipoprotein (LDL)
\end{itemize}

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\textsuperscript{19}Eldra Pearl Solomon, Linda R Berg and Diana W Martin. \textit{Biology}, Belmont Thomson Learning, 2005, 822 Print
Cholesterol\textsuperscript{23} is manufactured by the liver in the human body and it is an essential component of cell walls and building blocks of hormones. In the bloodstream, it is wrapped in protein “packages” called lipoproteins.

High Density Lipoprotein Cholesterol\textsuperscript{24} is also known as good cholesterol and scientifically, it is defined as the high-density lipoprotein (HDL) is one of the five major groups of lipoproteins which, in order of sizes, largest to smallest, are chylomicrons, VLDL, LDL and HDL, which enable lipids like cholesterol and triglycerides to be transported within the water-based bloodstream. In healthy individuals, about thirty percent of blood cholesterol is carried by HDL. HDL is the smallest of the lipoprotein particles. They are the densest as they contain the highest proportion of protein and cholesterol.

The American Heart Association\textsuperscript{25} provides a set of guidelines for fasting HDL levels and risk for heart disease.

Table I: Recommended Ranges of HDL-C

<table>
<thead>
<tr>
<th>Level mg/dL</th>
<th>Level mmol/L</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;40 for men, &lt;50 for women</td>
<td>&lt;1 03</td>
<td>Low HDL cholesterol, heightened risk for heart disease</td>
</tr>
<tr>
<td>40–59</td>
<td>1 03–1 55</td>
<td>Medium HDL level</td>
</tr>
<tr>
<td>&gt;60</td>
<td>&gt;1 55</td>
<td>High HDL level, optimal condition considered protective against heart disease</td>
</tr>
</tbody>
</table>

Low density lipoprotein cholesterol (LDL-C) also known as bad cholesterol and low density lipoproteins are like tiny containers in your bloodstream made of fat and protein. These containers carry cholesterol from your liver to the rest of the body. When your blood has too much LDL, the cholesterol may combine with other substances to form plaques on the walls of your arteries. The plaques make your arteries narrow and less flexible, which leads to a condition called atherosclerosis.


\textsuperscript{24}LDL and HDL Cholesterol What's Bad and What's Good\textsuperscript{29} American Heart Association Jul 2, 2009 <http://www.americanheart.org/presenter.jhtml?identifier=180> Retrieved October 8, 2009 > Web

\textsuperscript{25}Cholesterol Level, American Heart Association www.americanheart.org/presenter.jhtml 4500 Retrieved November 14, 2009 Print
Triglycerides\textsuperscript{26} are the chemical form in which most fat exists in food as well as in the body. They are also present in blood plasma and, in association with cholesterol, form the plasma lipids. Tryglycendes in plasma are derived from fats eaten in foods or made in the body from energy sources like carbohydrates. Calories ingested in a meal and not used immediately by tissues are converted to tryglycendes and transported to fat cells to be stored.

Very low density lipoprotein cholesterol (VLDL)\textsuperscript{27} stands for very low-density lipoprotein. It contains lipids, cholesterol, and other substances. Of all the body's lipoproteins, it contains the highest triglyceride content. VLDL is produced by the liver once the fats that were digested and absorbed into the bloodstream reach that organ. As VLDL circulates in the blood and interacts with fatty tissues, your body gradually converts it to low-density lipoprotein, or LDL. VLDL contains the highest amount of triglyceride. Since VLDL contains most of the circulating triglyceride and since the composition of the different particles is relatively constant, it is possible to estimate the amount of VLDL cholesterol by dividing the triglyceride value (in mg/dL) by 5. Increased levels of VLDL-cholesterol have been found to be associated with increased risk of heart disease and stroke.

Very low density lipoproteins, or VLDL, are molecules made up of mostly triglycerides, cholesterol and proteins. Very low density lipoproteins (VLDL), also known as the "very bad" cholesterol, carry cholesterol from the liver to organs and tissues in the body. It also serves as a precursor to low density lipoproteins (LDL).

Albumin, produced in the liver, is the major plasma protein that circulates in the bloodstream. Albumin is essential for maintaining the oncotic pressure in the vascular system. Albumin is also very important in the transportation of many substances such as drugs, lipids, hormones, and toxins that are bound to albumin in the bloodstream. Once the drug or other substance reaches the liver, it is detached from the albumin and made less toxic by conversion to a water-soluble form that can be excreted. A low serum albumin indicates poor liver function. Decreased serum albumin levels are not seen in acute liver failure because it takes several weeks of impaired albumin production before the serum albumin falls.

\textsuperscript{27}Jacqueline Gutierrez, Article reviewed by Mike Myers, www.livestrong.com/article/369980 definition-of-vldl-cholesterol Print
albumin level drops. The most common reason for a low albumin is chronic liver failure caused by cirrhosis. Abnormal levels of proteins carried in the blood can indicate problems in immune defenses, metabolism or the transport of nutrients. An excessively low level of albumin may mean that there is failing or intestinal disorders that are causing albumin to be lost in excessive amounts.

Bilirubin is the yellow-colored pigment that is formed from the breakdown of heme in red blood cells. The broken down heme travels to the liver, where it is secreted into the bile by the liver. Normally, a small amount of Bilirubin circulates in the blood. Serum Bilirubin is considered a true test of liver function, as it reflects the liver's ability to take up, process, and secrete Bilirubin into the bile.

Creatine is generated inside the body and is stored in the skeletal muscles in the phosphorylated form. When the muscle contraction takes place then the creatine and the creatine phosphate are continuously converted into creatinine. Creatinine is an unnecessary substance for the body and is thrown outside from the body by the kidneys. Creatine is a nitrogenous organic acid that occurs naturally in all vertebrates. Creatine helps to supply energy to muscle and nerve cells.

Physical Fitness. The centers of disease control and prevention (CDC) and American college of sports medicine defines physical fitness as, “a set of physical attributes that people have or achieve that relates to the ability to perform physical activity. The physical structure and degree of physical fitness can be improved by engaging in appropriate physical training.

According to medical doctors, “physical fitness is the functional capacity of the individual to perform a specific task.”

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According to the physical educators, "physical fitness is the total functional capacity of the individual to carry a desired last without undue fatigue or the capacity of the person to do sustained physical activity"

Physical Activity: It is defined as movement that requires any form of skeletal muscle contraction and results in energy expenditure beyond resting levels

Sports’ training is very much important to improve physical performance. There are many changes in the performance level in an athlete as a result of specific training. An important function of the training process is to increase the athlete's ability to tolerate and adapt to stress during training, both of which are functions of the intensity, the duration and the frequency of the stressors routinely applied throughout the training program.

Exercise: It is defined as a structured program designed to achieve a state of physical exertion of certain intensity, duration, and frequency. Exercise is physical activity that is planned, structured, and repetitive for the purpose of conditioning any part of the body. Exercise is used to improve health, maintain fitness, and is important as a means of physical rehabilitation. Endurance exercise is the one that involves the use of large groups of muscles and is thus dependent on the delivery of oxygen to the muscles by the cardiovascular system.

The historical roots of physical education date back as far as the ancient Chinese (c. 2500 B.C.), who had a well-developed system of exercise and physical training. In ancient Greece, the Athenians were concerned with both physical and mental development and consequently they accorded gymnastics, sports, and rhythm as an important educational role. During the period of the Roman Empire, and later during the middle ages, physical education was primarily used as a form of military training.

Interest in physical education as a part of the total individual's development was revived during the Renaissance. It was not until the 19th century, however, that systems of gymnastics were developed in several European countries, notably Germany, Sweden, and

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33Exercise <http://www.medical-dictionary.thefreedictionary.com/exercise/> Web
England. In the same century gymnastics spread to the United States. Interest in the new system led to a movement to have compulsory physical training in American public schools and to establish physical education in colleges and universities. The first department of physical education at an American college was established at Amherst.

Today, physical education is a required part of most school curricula, and a number of colleges and universities offer degrees in the field. Physical education classes generally include formal exercises, sports, and contests, although an increasing emphasis has been given to such Asian techniques as yoga, karate, and judo. The American Alliance for Health, Physical Education, Recreation and Dance (founded 1885) is concerned with improving its fields of education and to increase the public's knowledge and appreciation of physical education.

Over Training: It is the accumulation of training and non-training stress resulting in long term (i.e., several weeks or months or longer) decrement of performance capacity. A less deleterious version of overtraining is often referred to as 'overreaching', which is the accumulation of training and non-training stress resulting in short-term (i.e., several days) decrement of sports performance capacity' (Fry, A.C. 1998, Kreider et al., 1998). Some symptoms that are visible due to overtraining of sports in biochemical levels of human body are:

- Negative nitrogen balance
- Elevated basal metabolic rate
- Hypothalamic dysfunction
- Depressed muscle glycogen concentration
- Decreased bone mineral content
- Decreased hemoglobin or serum iron ferritin, mineral depletion Zn, Co etc
- Elevated cortisol levels or low testosterone
- Increased uric acid production

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34 Joe J et al., Textbook of Surgery IIIrd Ed, Massachusetts Blackwell Publishing Ltd, 2005, 579 Print
35 Keast D and A R Morton, Departments of Microbiology and Human Movement Research, the University of Western Australia www.rehabtoracing.com/overtraining.php
Overtraining should be controlled for better performance, if once work load is increased, then more resting period needs to be given for recovery of an athlete to come to normal performance level. If the training intensity is in a systematic manner the blood biochemical process also would respond according to the training and will increase slightly. If overtraining occurs, then many of the blood biochemical changes will lead to negative as well as positive effects in an athlete. Overtraining is a serious threat to anyone who aims to make gains in his/her performance. Early recognition and employment of right strategies to halt or prevent it, allows no space for worry. If you have over trained, you may find it difficult to stop but you must, as the rewards will be in the form of increased size, strength and quality of life. The performance of an athlete will increase only if he or she will do the training with progressive load. Many terms like super compensation and overtraining, support the improvement in performance level of athletes and increase their fitness levels. Single session of training and taking blood sample will show variations in Blood parameter to normal value which happen due to vasodilation. Vasodilation refers to the widening of blood vessels resulting from relaxation of smooth muscle cells within the vessel walls, particularly in the large arteries, smaller arterioles and large veins. The process is essentially the opposite of vasoconstriction, or the narrowing of blood vessels. When vessels dilate, the flow of blood is increased due to a decrease in vascular resistance. The primary function of vasodilation is to increase blood flow in the body to tissues that need it most. This occurs often in response to a localized need of oxygen, but can occur when the tissue in question is not receiving enough glucose or lipids or other nutrients.

The human body is like a machine, till the death, the physiological function will keep on working together. When we exercise, our breath will be heavier and faster, heart beats faster, muscles hurt and we start to sweat. These are all normal responses to exercise and our body has an incredibly complex set of processes to meet the demands of working muscles. In strenuous exercise, just about every system in our body either focuses its efforts on helping our muscles do their work, or it shuts down. Heart beats faster during strenuous exercise so that it can pump more blood to the working muscles, and stomach shuts down during strenuous exercise so that it does not waste energy for digestion, and the same energy saved is supplied to the muscles. When a person is doing exercise, the muscles act similar to electric motors. Muscles take in a source of energy and they use it to generate
An electric motor uses electricity to supply its energy. Our muscles are biochemical motors, and they use a chemical called adenosine triphosphate (ATP) for their energy source. During the process of "burning" ATP, muscles need three things:

- They need oxygen, because chemical reactions require ATP and oxygen is consumed to produce ATP.
- They need to eliminate metabolic wastes (carbon dioxide, lactic acid) that the chemical reactions generate.
- They need to get rid of heat.

**Table: II  The normal values of various blood parameters**

<table>
<thead>
<tr>
<th>No</th>
<th>PARAMETER</th>
<th>NORMAL VALUE FOR BOYS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>White blood cells (WBC)</td>
<td>4000 – 10000 cells/cu mm</td>
</tr>
<tr>
<td>2</td>
<td>Red blood cells (RBC)</td>
<td>3.8 – 5.8 million/cu mm</td>
</tr>
<tr>
<td>3</td>
<td>Haemoglobin</td>
<td>13 - 17 gm/dl</td>
</tr>
<tr>
<td>4</td>
<td>Platelets</td>
<td>1.5 – 4.0 lakh/ cu mm</td>
</tr>
<tr>
<td>5</td>
<td>Bilirubin</td>
<td>0.2 – 1.0 mg/dl</td>
</tr>
<tr>
<td>6</td>
<td>Total Protein</td>
<td>6 – 8.3 g/dl</td>
</tr>
<tr>
<td>7</td>
<td>Albumin</td>
<td>3.5 – 5.0 g/dl</td>
</tr>
<tr>
<td>8</td>
<td>High density Lipoprotein (HDL)</td>
<td>35 – 65 mg/dl</td>
</tr>
<tr>
<td>10</td>
<td>Low density Lipoprotein (LDL)</td>
<td>65 – 150 mg/dl</td>
</tr>
<tr>
<td>11</td>
<td>Total cholesterol</td>
<td>140 – 220 mg/dl</td>
</tr>
<tr>
<td>12</td>
<td>Electrolytes Sodium</td>
<td>133 – 143 mEq/L</td>
</tr>
<tr>
<td>13</td>
<td>Potassium</td>
<td>3.5 – 5.5 mEq/L</td>
</tr>
<tr>
<td>14</td>
<td>Blood Sugar Level</td>
<td>60 – 140 mg/dl</td>
</tr>
<tr>
<td>15</td>
<td>Creatinine Kinase</td>
<td>Upto 190 IU/L</td>
</tr>
</tbody>
</table>