CHAPTER - I

1.INTRODUCTION

In today's world, Physical Education and Sports play an important role in the development of physical, intellectual and social aspects of life. Sport has got woven into the fabric of modern life, providing a counter weight to excessive comforts and indulgences of today. In developing countries, it helps to fight the frustration of the youth, who otherwise become easy victims to boredom because of Lack of Opportunities.

Sports achievement of a country depends mostly on the training designed for particular sports. If our nation desires to win in international competitions, it must take the challenge seriously in terms of well developed training programmes. Our performance in sports and games, at international level has been successful and we have nothing to boast of any events.

Sports movement gaining momentum by scientific investigations in modern times in terms of training, tactics, equipment and identification of champions, selection of training have been given much emphasis, since victory in the sport field is looked forward and celebrated as an event of national glory. The fact may be of greatest significance where there is political rivalry or a clash of culture and tradition. **(Sharma**, **1984**)

The research has produced valid and precise information about the relative effects of training methods. As a result, we know much more than before about how

to develop endurance, power, agility, speed and other athletic skills. In the recent years, we have gained new knowledge about almost every aspect of conditioning and performance.

Training is a systematic process of repetitive progressive exercise of work involving also bearing process and acclimatization.

Physical training brings a lot of change in the body that is

1. An increase of maximum respiratory minute diffusing capacity.
2. Possibly a slight increase in oxygen diffusing capacity.
3. Ten to thirty percent increase of maximum oxygen uptake.
4. An increase in stroke volume and maximum cardiac output.
5. An increase in size of heart.
6. An increase in total hemoglobin and blood volume.

Circuit training is designed to develop cardio respiratory endurance as well as flexibility, strength and endurance in essential muscle groups. It is an efficient training method in terms of gain made in a short time. **(Amhelm,1985)**

1.1 FITNESS IN PAST AND FUTURE

From time immemorial human ability to perform any physical feat differs from man to man. Man tried to excel in one way or the other. Fitness was a natural talent present in olden days with every man as a matter of existence. If he was fit, he would lame that he couldn't hunt and eat. To avoid another human depending on

for his food, he learned to be fit. Thus historic, man right from his evolution lived fit out of his necessity of very existence and survival**. (Anclesson.,1971)**

1.2 NEED FOR PHYSICAL FITNESS

It was among nations that physical exercises lead to pain, failure and embracement.

Physical Fitness

It is the ability to perform daily tasks with sufficient strength and vigor without experiencing undue, fatigue and to have enough strength and stamina leftover to enjoy recreational and be able to meet unforeseen emergencies.

It is only through physical activity; physical fitness is built and maintained. If one has improves his physical fitness, it can be presumed that he has improved the efficiency of heart and lungs.

Jackson started that physical fitness make you feel mentally sharper, physically more comfortable and more in tune with your body and be able to cope up with the demands that everyday life makes upon you. Physical Fitness depends on the nature of activity one is involved. For a man who earns his livelihood by doing hard physical work, physical fitness means strength and stamina. For a dancer, her flexibility and suppleness may indicate the level of physical fitness. Thus, total physical fitness involve, the combination of strength, stamina, flexibility, endurance, rhythm, balance, etc., Total fitness is in the idea state just as no human being is

perfect, no one is totally fit too. When physical fitness is defined, it may be good to describe two types of physical fitness as health related and performance related fitness.

1.3 TRAINING AND SPORTS PERFORMANCE

Sports training is planned and controlled process in which achieves a goal, changes is complex sport motor performance ability to act and behavior is made through measures of content, methods and organization. Sport training is done for improving sport performance. The sport performance as any other type of human performance is not the product of one single system or aspect of human personality. Sport training is not more physical activity involving physical movement or action, play dance, physical or femoral work like household work, industries and factories.

Sports' training is a process of preparation of sportsman based on scientific and pedagogical principles for higher performance.

The sports training is the total process of preparation of sportsman by different means and forms like developing physical fitness. Techniques and tactics, cognitive and volitional and perceptual abilities, personality traits, positive beliefs, values attitudes and interests for training and competition.(**Jacken,**1985)

1.4 PHYSICAL ACTIVITY AND MENTAL HEALTH

There has been a growing recognition that being physically active is associated with improved mental health including improving aspects of mental wellbeing and

preventing the development of mental health problems. In addition, the potential for physical activity to alleviate the symptoms of various mental illnesses is noted.The following benefits of physical activity to mental health are indicated in the literature:

Perception Of Mental Wellbeing: physical activity (particularly moderate active living type like walking) is linked with improved self perception of mental wellbeing;

Self Esteem: physical activity is linked to positive effects on self esteem and self perceptions

Cognitive Function*:* there is some evidence that physical activity can promote some aspects of cognitive functioning such as memory, reasoning, problem solving and spatial awareness – this work has particularly emphasized the potential for physical activity to contribute to educational attainment within young people and to maintain good cognitive functioning in older people

Sleep*:* those who are active tend to fall asleep faster and sleep longer and deeper than those who are inactive – the likelihood of having sleep disorders in lower amongst those who are active

Stress & anxiety reduction: those who are active tend to be able to cope with stress better – this can act at a general long term level (trait anxiety) or immediately (state anxiety).

1.5 TRAINING

The word 'training' has been a part of human language since ancient times. It denotes the process of preparation for some task. This process invariably extends to a number of days, even months and years. The term training is widely used in sports. There is, however, some disagreement among coaches and also among sports scientists regarding the exact meaning of this word. Some experts, especially belonging to sports medicine, understand sports training as basically doing physical exercises.

Sports' training is a systematic process extending over a long period. For best results the system of training has to be based and conducted on scientific facts and lines. If it is not possible, the training has to be based on the result of successful practice which has withstood the test of time. Sports science is still unable to provide a scientific base for all the aspects and elements of training. Many things are still based on the results of successful practice, which on deeper analysis is also a method of science to prove or disprove a theory. Moreover, the principal characteristic of science is the existence of a systemized body of knowledge. The science of sports training has its own systemized body of knowledge and so it is a science in itself **(Singh,1991).**

"Sports training is a planned and controlled process in which, for achieving a goal, changes in complex sports, motor performance, ability to act and behavior

are made through measures of content, methods and organization" **(Martin, 1979).**

Williams (2000) defines "Sports training is a process of preparation of sportsman, based on scientific and pedagogical principles for higher performance."

Training means preparing for something: an event, a season, an athletic competition, a nursing career, an operatic performance, or military combat. Much growth and change occur during training. It usually involves learning or polishing skills, enchanting attitudes, developing and strengthening organs and their functions. When we train, we have something in mind; a goal, a level of competence, a performance of some kind. An aspiration is established in our mind, which we systematically pursue. We get prepared to meet the increasing demands of some of kind with respect to our current mental or physical resources. We seek in some way to change and make better our present status, to improve our previous level of performance.

Training is a programme of exercise designed to improve the skills and increase the energy capacities of an athlete for a particular event **(Edward, 1984).**Training is the total process of preparation of a sportsman, through different means and forms for better performance **(Singh, 1983).**

Sports Training, based on scientific knowledge, is a pedagogical process of sports perfection which through systematic effect on psycho-physical performance ability and performance readiness aims at leading the sportsman to the highest

performance. Through active and conscious interaction with the given demands in sports training, the sportsman's personality develops according to the norms and standards of socialist society **(Harre, 1986).**

1.5.1 CONCEPTS OF TRAINING

Training is a pedagogical process, based on scientific principles, aiming at preparing sportsmen for higher performances in sports competitions. It aims at improving the performance of sports persons. The performance of a sports person primarily depends on the performance capacity which is a complex group of factors. The constitution or physique is genetically determined and so it cannot be improved by training. The improvement and maintenance of physical fitness is the main concept of training.

Training is not mere physical activity involving physical movements or actions. Such type of physical activity is common to several types of human activities, e.g. play and dance, physical or manual work like house hold work, work in industries and factories.Sports training mainly aims at achieving higher 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.

In order to achieve high performance, sports' training is done in a planned and systematic manner. A system which is the most suitable one for achieving high performance has to be first made on the basis of the planned sports training.

1.5.2 PRINCIPLES OF TRAINING

Principles of training are the guide-lines for coaches, teachers and sports persons for the formulation and control of sports training. These principles are valid for all aspects and elements of training. These are formed on the basis of knowledge gained from various sports science disciplines and successful practice. The principles of training can be general or specific. General principles are valid for the process of sports training as a whole. The specific principles are applicable to a limited part or aspect of training only.

The training should be a continuous and regular process. Continuous and regular training leads to the improvement of performance capacity. The sportsman must be educated about the importance of continuity of training by convincing him about the negative effects of training breaks and irregular training on his performance capacity.

The training load is the principal stimulus for starting the psycho-physical processes of adaptation which eventually leads to the increase in performance capacity. A quantum of training load forces the organism to adapt to a certain level of psychic and physical demands. If the same load is repeated, it gradually loses its value as a stimulus for adaptation. Higher performance will be achieved when the organism adapts to a higher level of functioning, and this is possible only by increasing the load.

The training programme should be formulated uniformly but allowing for individual differences. Uniformity means that training for all should be based on the same principles and system which have been worked out to achieve the prognostic sports performance in stages.

According to **Singh (1984)** training aims at improving the fitness of a person and promoting the acquisition of basic movement skills. To achieve this, training should have some basic principles and the most important basic principle of training is overload. Most Physiological systems can adapt to functional demands that exceed these loads encountered in normal daily life. Training often systematically exposes selected physiological systems to intensities of work or function that exceed those to which the system is already adapted. Excessive overload has to be avoided because physiological system cannot adapt to extreme consistency as the most physiological systems require exposure to overloading activities three times a week or more. The required frequency of training however depends on the season, the athlete, the activity and the specific components of fitness. There is no substitute for consistency in a training programme. The athlete might participate in training that are highly specific to the participation of physiological system overload, to the particular muscle group used, and to the particular muscle fibers performing the work progression in the successful training programme plan for a steady rate of progression over a load period. The athlete has to improve over several years of participation; the training programme must progress so that the appropriate physiological systems continue to be overloaded.

However, too rapid increase of the training stress may lead to exhaustion and impaired performance.

Apart from these principles one has to give due attention to the individuality. Factors such as age, sex, maturity, current fitness level, years of training, body size, somatic type and psychological characteristics should be considered by the coach in designing each athlete's training regimen.

There are certain principles that govern on how the body responds to the physical activity. Following principles will ensure the safety and effectiveness of the activity programme.

Overload Principle states that a body system (muscular, skeletal) must be exposed to physical stress beyond the ordinary in order to adapt and improve function. For example, to build stronger muscles one must work against resistance that pushes the muscles to their limits. Over a period of time, the muscles adapt to this new workload and become stronger.

Principle of Progression states that, to ensure safety and effectiveness, the overload must be applied in a systematic and logical fashion. If too much physical stress is applied too soon, the system will not have time to adapt properly and benefits may be delayed or injury may occur. The body may be overloaded gradually so that it has no time to adjust and improve. If the muscles are sore after exercising, they are doing more than their current level of fitness. One should reduce the intensity of the activity and progress more gradually.

Principle of Specificity states that particular activities must be performed to bring about particular adaptations. For instance, if the goal is to build muscular strength, you need to undertake an activity that overloads the muscles. For example, one must do exercise that physically stress the biceps muscles of the upper arm if strength gain in the biceps is desirable. Stressing the quadriceps muscle of the thigh will not develop strength in the biceps of the arm.

Principle of Reversibility tells that, any gains may get through regular physical activity will disappear, if we do not continue to be active – thus the maxim"Use it or lose it". If we decrease our activity levels, we will experience some loss in fitness, in as little as two weeks **(Coyle, 1990).** Therefore, it is important to continue our activity programme for life.

Principle of Individuality reinforces the concept that all people have different genetic blueprints, and activity programmes must be designed with this in mind. Determine what one wishes to achieve, find activities that will bring about those results, and set out to obtain the desired outcomes.

Principle of Recovery reminds that the body takes time to adjust to the physical stress of being active. One must allow adequate time for adaptation to take place. It is generally recommended that one should allow 48 to 72 hours between exhaustive activity sessions, those are similar in nature. This doesn't mean that one shouldn't be active at all for this period of time. It does mean that

one should vary the activities so that one system is allowed time to adjust before it is stressed again **(Thomas, 2007).**

1.5.3 AIM OF SPORTS TRAINING

In the light of the meaning and definitions of sports training, the major aim is to improve rapidly the sports performance of a sports person particularly in sports competitions, which is mainly based on his physical, psychological, intellectual and technical capacities and capabilities. In other words, the aim of sports training in competitive sports is to prepare the sportsperson for the attainment of highest possible sports performance in competition **(Singh, 2008).**

The definition of sports training gives the overall aim of training process. This is the major aim which can be subdivided into different aims, achievement of which is necessary to improve the sports performance. These aims are related to different performance factors and are described briefly in the following.

I. Improvement of physical fitness

The sports performance depends largely on physical fitness that is strength, speed, endurance, flexibility and various coordinative abilities. Sports activity is a physical activity, which is not possible without these motor abilities. Therefore, the improvement of physical fitness or motor abilities is a principal aim of sports training. The process of improvement of motor abilities is also called conditioning. Improvement of physical fitness also includes the improvement of

general health and organic functions as well as increase in the strength and stability of the musculoskeletal system. Each sports activity demands different types and levels of motor abilities and when a sportsman possesses these, is said to have the specific physical fitness. General physical fitness is the level of various motor abilities, regardless of any sport, which the sportsman possesses. The contribution of general physical fitness towards the sports performance is indirect. But it should never be over looked that specific physical fitness depends largely on the general physical fitness.

II. Acquisition of motor skills

Technique is the motor procedure of tackling a sports task and when this motor procedure is learned and stabilized, it is called a skill. Sports activities consist of motor movement and action, and their success depends largely on their correctness. Skills are indispensable for maximum utilization of the motor abilities and for successful execution of tactical actions. Hence, technique training forms an important component of sports training which aims at acquiring skill of the specific sport, of other sports as well as of the various physical exercises. The role of technique and the amount of technique of training defer from sport to sport. In gymnastic, team and combative sports, there are a large number of techniques to be learnt and mastered. On the other hand, in track and field, weightlifting, etc., only one or two techniques have to be learnt and mastered.

III.Improvement of tactical efficiency

Tactics is carrying out a competition in such a way that the sportsman can fully utilize his abilities, skills and external factors while at the same time hindering the opponent to do so. The role of tactics is different in different sports. The performance in 100 meter sprint does not depend significantly upon the tactical factor, but in team and combative sport, a good performance without tactical efficiency is impossible. Therefore, the improvement of tactical efficiency is an important aim of sports training. The tactical training aims at improving the knowledge of rules and regulation of the specific sport and how this and other factors can be exploited by the sportsman, for better performance during the completion, improving the tactical abilities and at improving tactical skills. It must be noted that with the improvement of sports performance of a sportsman, the aim of improving tactical efficiency becomes more and more important.

IV. Educational and improvement of mental capabilities

Performance in sports is a result of the total personality of the sportsman. Therefore, the educational and improvement of mental capabilities must be considered in sports training. Education, in short, means:

1. Development of positive beliefs, values, attitudes and interest towards sports training and competition.

2. Development of personality traits and quality which are important for successful training and competition, e.g., self control, regularity, honesty, quality of hard work, courage, social qualities, etc.

3. Formation of good habits, e.g., eating and sleeping habits, leisure time habits and habits of personal hygiene. The sportsman should be educated not only for the purpose of training and competition, but also to become valuable members of the society and the nation. The educational aim of the sports training must conform to the educational aim of the society.

For successfully carrying out the training and competition activities, a sportsman must have certain mental capabilities, e.g., intelligence, ability to concentrate, thinking ability, problem-solving ability, ability to take quick and correct decisions, etc. Such mental capabilities form a part of education, and should be improved.

The educational and improvement of mental capabilities must take place through sports training and competitions. Hence, the training process must be consciously planned according to the principles of pedagogy. Training and competitions are important means to achieve this and it is the moral, social and professional duty of each coach and physical education teacher to educate the sportsman through training and competitions.

1.6 TRAINING LOAD

Training load is the central concept in sports training as it leads to increase in sports performance. For improvement of sports performance, the training load also is to be increased. Stagnation in training load means stagnation in performance. Sports training can be compared to stimulus reaction process. By giving load, stimulus is given to the organism which reacts in the form of adaptation to that stimulus. In the sports training, the load leads to functional, bio-chemical and structural adaptation of the organism for higher demands.

Training load is the psychological and physiological demands put on the organism through motor stimuli (movements) resulting in the improvement or maintenance of performance capacity.

Every physical activity accompanies physiological demands. This is generally recognized and accepted. But most of the times it is overlooked that physical activity also puts psychological demands on the sportsman. A competition or trial is characterized by high psychological demands. Technical, tactical and endurance training are also accompanied by high psychological demands.

The training load must satisfy one important condition, i.e., must lead to an increase or maintenance of performance capacity.

External load

It is the work done by the sportsman. The total distance run by a distance runner is one aspect of external load. The external load can be divided into various load components which shall be discussed later.

Internal load

It is the degree and extent of psycho-physiological reaction of the sportsman to external load. The degree of internal load is judged by pulse rate, lactic acid concentration in the blood, and various biochemical changes in the tissues. The degree of internal load can also be judged by various symptoms of fatigue.

External and internal load are inter-related. External load is the cause of internal load. For biological adaptation (performance improvement) internal load is a must and should be optimum. In other words, the aim of doing exercises (i.e., giving of external load) is to produce internal load. The sports training, therefore, is internal load oriented and external load is only a means of causing internal load. Same external load may not result in the same degree of internal load in two sportsmen in different levels of training state. For top level sportsmen, higher external load is necessary to produce optimum internal load, i.e., with improvement of training state more external load should be given to produce a certain degree of load. The principles of load can be described as follows:

Principles of continuity and repetition of load

The load must be given several times in order to achieve a stable increase in performance capacity. Further, the training should be continuous, otherwise the achieved adaptation or performance improvement will be lost after some days.

Principles of optimum load

If load given is less,very little or no super-compensation takes place. If excessive load is given, the recovery process is slowed down. Therefore, for optimum recovery and super-compensation, optimum load should be given.

Principles of load and recovery

Optimum load is essential to achieve good super-compensation. But super compensation will take place only if enough time for recovery is given. For super

Compensation, recovery is as important as load **(Jakowlev,1977 and Schube, 1979)**.

Principles of specificity of load

A specific type of load leads to super compensation of a particular type of substance. Therefore, after recovery, one's performance capacity is improved for that load only which has caused super compensation. Different types of load should be given when different performance factors need to be improved.

Principles of progression of load

For continuous improvement of performance, the load should be increased from time to time. A particular quantity of load leads to adaptation to tackle the load successfully. But it will not help in tackling loads, for which the adaptation takes place at a higher level. Therefore, higher load should be given so that adaptation to a higher level can take place.

1.6.1 COMPONENTS OF LOAD

The components of load, as important aspects or elements of training load, have been discussed by various authors **(e.g. Harre, 1979; Martin, 1977; Letzelter, 1979; Berger, 1980).** The components of load are various aspects of load which determine the degree of load. One cannot predict what will be the effect of physical activity done for 20 minutes unless and until one knows some other aspects of load also, e.g., the intensity, the density, etc. By properly controlling the load components, we can achieve the desired effect through physical activity.

Intensity

It is the rate of doing work. In other words intensity is the pace at which physical activity is done. An activity can be carried out with different intensity which will have different effect on the organism. Hence, in practice, the total range of intensity is divided into various zones. This is important for planning,

implementation and evaluation of the training. The highest intensity which can be achieved by the sportsman is taken as 100% and this is used as a reference point for the various intensity zones. In endurance training, the intensity zones are made according to the heart rate.

Density

If the training activity is done with pauses in between, the intensity is affected to a large extent by the density. The density characterizes the temporal relationship between load and recovery phases in a training session. Most commonly, it is referred to as the rest period between two motor stimuli. If more stimuli is given in a certain time period, the training is denser, i.e., the density is high. The density is determined by the aim and objective of the training activity. The role of density is two-fold.

Volume

It is the total amount of work done in a training session. When the activity is done according to continuous method, the total distance covered, or total number of repetitions or the total duration of the activity is referred as the volume. Like intensity, the volume should also be optimum in order to have some effect on the organism, e.g., for the development of basic endurance. One should run continuously for at least 30 minutes **(Harre, 1979)**. In training activity, which is

done with a pause in between, the volume is usually the product of duration of stimulus and frequency of stimulus.

Duration of stimulus

It is the time period for which single motor stimulus acts on the organism. Optimum duration of stimulus is important to start the desired adaptation process, e.g., for the development of acceleration ability, the duration of each repetition should be at least 6 seconds. In some activity the duration of stimulus can be so short that it may not carry any significance for the calculation of load, e.g., in jumps and throws. In cyclic movements, the time period of a series of motor stimuli is taken as the duration of stimulus, e.g., in endurance training, the duration of stimulus is the total volume of load itself. The duration of stimulus together with other load components, determines the effect and direction of load. For the development of isometric strength, the muscle contraction should last for at least 20 – 30% of total time for which the contraction can be held. In speed training, the duration of each repetition should only be that much for which the maximum intensity can be maintained. Same is the case in technique training.

Frequency of stimulus

It is the number of times a motor stimulus (repetition) is given. In cyclic activities like swimming, running, etc., there is no frequency of stimulus as there is only a long duration stimulus. In interval and repetition methods, it is the

number of repetitions. In weight training, it is the number of repetitions of an exercise. Same is the case in jumps, throws and free-hand exercises. In activities where duration of stimulus may not be considered for the calculation of load volume, the frequency of stimulus is taken as the volume of load. Frequency of stimulus and intensity are interdependent. If higher is the intensity, the lower will be the frequency and vice versa.

Judgment of load

It is very important for the coach to know how much load is given to the sportsman during a training session. The external load can be measured and controlled, and it should be only that much which results in optimum internal load on the sportsman. Unlike external load, the internal load is not easy to determine, because the coach must find out at what level the organs and systems of the body are working, and what is the degree of fatigue.

1.7 PILATES TRAINING

The Pilates method, developed by the legendary physical trainer **Josephpilates**, is a full body exercise system. Emphasizing body alignment and correct breathing, Pilates uses the abdomen, lower back, and buttocks as a power center, enabling the rest of the body to move freely. A series of controlled exercises and specialized equipment create variable resistance for muscular exertion. The primary mechanism used in Pilates is the universal reformer, a bed-like platform with a carriage that slides along tracks. The carriage may be moved by pushing against a

bar or pulling leather straps with the arms or legs. Exercises are performed from a reclining, sitting, kneeling, standing position. Other areas of the body may be strengthened on the barrel, chair, and mat.

1.7.1 BENEFITS OF PILATES TRAINING

Everyday activities such as sitting, standing, running, playing sports, dancing, or working out in a gym, strengthen some muscle groups; but may leave other muscle groups weaker and underdeveloped. The resulting muscular imbalance may never be noticed but it can eventually become a source of fatigue, discomfort, pain, and even immobility. The pilates method of Physical and Mental Conditioning facilitates muscular harmony and balance. People who consistently use the pilates method discover that without conscious effort they improve their posture, move more gracefully, sleep better, and develop firmer, sleeker, and more powerful muscles. Joseph pilates spent more than 50 years refining his exercise system that used memory and musculature to create mental and physical harmony. His goals are achieved as each pilates student demonstrates the full measure of his or her capabilities.

1.7.2 MAT PILATES

Pilates mat work is a series of exercises that are done on the floor without Pilates machines. The attention to the flow of movement and to the core, muscles is the same as when you do Pilates on the machines, and mat work is a challenging workout its own right.

1.7.3 PRINCIPLES OF PILATES TRAINING

To understand Pilates' method, we first need to understand the principles behind the technique and why they are so essential.

The eight principles are:

1. Concentration
2. Centering
3. Breathing
4. Control (including strength)
5. Precision
6. Flowing Movement
7. Isolation (including flexibility)
8. Routine

These eight principles may at first, appear simple and logical in their individual parts, but it can be challenging to remember all of them at the same time when performing even a simple exercise. When you first begin the program, focusing on some efforts of even two of them .Slowly, as you are able to master one principle at a time with some of the more basic exercises, you will discover the enormous effect that even a slight variation of the movement can have on the effort required to perform that movement. It is the mind's subconscious control over habitual.

1.7.4 OUTCOMES OF PILATES TRAINING

Pilates exercises strengthen the diaphragm, stretch tight muscles, and improve posture - all of which help you run longer with less effort. Development of a strong core and postural awareness minimize injuries. Pilates exercise is a good conditioning and cross-training program for runners. As running exerts great stress on the lower back and lower joints, any imbalance in the muscular usage of the legs and hips can cause pain and injury to a runner. Pilates is very effective at developing the stabilization muscles around the pelvis and strengthening the core. Pilates also highlights the awareness of good posture so that your upper body is more upright, leading to a better alignment and less prone to injury while running. Flexibility Allows You to Have Bigger & More Powerful Strides

Pilates improves flexibility and range of motion without compromising strength as you are strengthening and stretching your muscles simultaneously. Especially if you run on uneven ground or trails, a strong and flexible core will protect your back and absorb shock impact that comes with every step. It is important to balance your body and train muscles that may be neglected when you do your runs.

Pilates enables runners to breathe deeper so as to sustain longer runs some runners take deep breathes for the majority of their run and switch to high-chest breathing when they sprint. There are many ways to breathe for different outcomes and Pilates can help you to develop stronger breathing muscles. Pilates which involves deep diaphragmatic breathing pre-activates the transverse abdominals, pelvic

floor and diaphragm. It creates an even and sustained breath and this can prevent you from getting side cramps when running; as it is like a deep massage for the diaphragm and other breathing muscles. It also heightens your concentration and allows better mental focus. Pilates Reduces Running Injuries and Is an Excellent Knee Rehabilitation Program

Knee joint, being the largest and most complicated joint in the body, is always subjected to a heavy workload during all the sports activities, especially running. Pilates is the most important way to keep away from knee injuries as it strengthens the hip adductors and quadriceps which keeps the knee and hip joints more stable. Pilates work well as a part of knee rehabilitation as it helps to restore the joint function and correct the joints movement patterns by emphasizing body awareness. In short, Pilates enhances the biomechanics of the runner, build strength, increase flexibility and reduces the risk for common injuries associated with running. Doing Pilates two to three times a week would be the best for runners. Integrates Pilates into your current running program right now to further enhance your running performance.

Pilates training may result in improved flexibility. However, its effects on body composition, health status, and posture are more limited and may be difficult to establish. Further study might involve larger sample sizes, comparison with an appropriate control group, and assessment of motor unit recruitment as well as strength of truncal stabilizers. Pilates helps in the treatment of chronic lower back pain to improve functional ability and symptoms.**(Kunasingamand Shuen, 1994)**

1.7.5 PILATES TRAINING AND PHYSICAL CHANGES

Pilates training was initially practiced almost exclusively by athletes and dancers. However, in recent years, Pilates has become a popular trend in rehabilitation and fitness. In the United States, there are over 5 million practitioners, and an Internet search reveals that over 200 videotapes are available. Pilates training is intended to improve general body flexibility and health by emphasizing “core” (truncal) strength,

In Posture and coordination of breathing with movement, Joseph Pilates noted that mobilizing early in rehabilitation resulted in a reduced convalescence period after musculoskeletal injuries. Advocates report that the exercises can be adapted to provide either gentle strength training for rehabilitation or challenge skilled athletes with a vigorous workout. Stott Pilates altered Pilate’s original program by incorporating more preparatory exercises and modifications in hopes of improving safety and maintaining neutral spine position. Pilate’s exercises are designed to put participants in a position that minimizes unnecessary muscle recruitment, which could potentially lead to early fatigue, decreased stability, and impaired recovery.

Pilates training, focusing on back extensors and the abdominal musculature, in particular the transverses abdomens is referred to as core strengthening. Ostensibly, the goal of core strengthening without straining peripheral joints is realized through concentrating on coordinating breathing with movement; scapular, pelvic, and rib cage stabilization during abdominal movements; and head and cervical spine placement to avoid neck strain. Pilates instructors provide physical assistance and verbal feedback to maximize accuracy as well as safety during exercise. The Pilates mat exercise progression initially uses a wide truncal base of support in prone, side-lying, or supine positions, while moving the limbs to vary torque on truncalmuscles. As the participant develops improved strength and form, the base of support is gradually reduced to retrain proprioceptive mechanisms while fostering more efficient movement patterns. This is similar in principle to the dynamic stabilization

exercises widely used in the treatment and prevention of musculoskeletal, low back pain (LBP), which advocates promoting efficiency of deep stabilizers and decreasing contraction of muscles counterproductive to the activity. **(Neil A. Segal 2004)**

1.7.6 PILATES TRAINING AND PHYSIOLOGICAL CHANGES

The World Health Organization defines health as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity." To achieve such a state of health, many patients seek complimentary programs for wellness rather than depend on treatments only when ill. Some of the complementary approaches gaining popularity may contribute to improved flexibility, body composition, and health status. For physicians to be able to offer evidence-based guidance for patients seeking advice about complementary programs, it is important to assess the potential benefits and side effects. One exercise approach frequently referred to as Pilates, because of a foundation in the teachings of Joseph Pilates.

Pilates yields numerous benefits, increased lung capacity and circulation through deep, healthy breathing is a primary focus. Strength and flexibility, particularly of the abdomen and back muscles, coordination-both muscular and mental.are key components in an effective Pilates program. Posture, balance, and core strength are all heartily increased. Bone density and joint health improve, and many experience positive body awareness for the first time. Pilates teaches balance and control of the body, and that capacity spills over into other areas of one's life.

Proprioception forms the link between the musculoskeletal and nervous systems, which is essential for spinal stability. It is postulated that inhibition of deep proprioception, due to pain or habit, may lead people to develop compensatory movement patterns, which prolong the healing process because of ineffective biomechanics after injury. Through retraining truncal stabilizers, Pilate's exercises may contribute to improved movement patterns. Additionally, Pilates involves closed kinetic-

Chain exercises, which may provide the necessary compressive and decompressive forces to foster nutrition to joints and cartilage to reduce degenerative risk. Thus, the claims are

Valid and training is safe; Pilates may have a role in attenuating the predisposition to chronic axial musculoskeletal pain caused by spinal instability. Pilates is marketed to athletes, the general population, and people with medical conditions such as rheumatoid arthritis with the claims that it: “balances strength and flexibility”; “produces longer, leaner muscles”; “improves posture”; “increases core strength and peripheral mobility”; “helps prevent injury”; and “enhances functional ease of movement.” Marketers also claim that Pilates training heightens body awareness, is easy on the joints, improves performance in sports (eg, golf, skiing, skating, dance), and improves balance, coordination, and circulation. (Jeffrey. R 2004)

1.8 PLYOMETRIC TRAINING

Plyometrics (also known as "plyos") is a type of exercise training designed to produce fast, powerful movements, and improve the functions of the nervous system, generally for the purpose of improving performance in sports. Plyometric movements, in which a muscle is loaded and then contracted in rapid sequence, use the strength, elasticity and innervations of muscle and surrounding tissues to jump higher, run faster, throw further, or hit harder, depending on the desired training goal. Plyometrics is used to increase the speed or force of muscular contractions, providing explosiveness for a variety of sport-specific activities. Plyometrics has been shown across the literature to be beneficial to a variety of athletes. Benefits range from injury prevention, power development and sprint performance amongst others.

Plyometric exercise refers to those activities that enable a muscle to reach maximal force in the shortest possible time. “Plyometric” is a combination of Greek words that

literally means to increase measurement (plio = more; metric = measure). Practically defined, plyometric exercise is a quick, powerful movement using a pre-stretch or counter movement, which involves the stretch-shortening cycle (SSC). The purpose of plyometric exercise is to increase the power of subsequent movements by using both the natural elastic components of muscle and tendon, and the stretch reflex. To effectively use plyometrics as part of a training programme, it is important to understand: (1) the mechanics and physiology of plyometric exercise, (2) principles of plyometric programme design, and (3) methods of safely and effectively performing specific plyometric exercises. **(Baechle *et al.* 2008).**

For a muscle to cause movement it must shorten; this is known as a concentric contraction. There is a maximum amount of force with which a certain muscle can concentrically contract. However, if the muscle is lengthened while loaded (eccentric contraction) just prior to the contraction, it will produce greater force through the storage of elastic energy. The quick transition from the eccentric to the concentric phase is known as the stretch shortening cycle (SSC), and is one of the underlying mechanisms of plyometric training. The force created by the muscle-tendon during the SSC is determined by the muscle's length and compliance. To increase power through plyometrics, two integral controlling aspects are required. These aspects include “a more rapid initial stretch, which generates more power in the muscle group moving in the opposite direction in the second phase of the action; and a shorter time between eccentric and concentric contractions (SSC)".

The muscle spindles are involved in the stretch reflex and are triggered by rapid lengthening of the muscle as well as absolute length. At the end of the rapid eccentric contraction, the muscle has reached a great length at a high velocity. This may cause the muscle spindle to enact a powerful stretch reflex, further enhancing the power of the following concentric contraction. The muscle spindle's sensitivity to velocity is another reason why the amortization phase must be brief for a plyometric effect **(Brooks, 1996)).**

A longer term neurological component involves training the muscles to contract more quickly and powerfully by altering the timing and firing rates of the motor units. During a normal contraction, motor units peak in a de-synchronized fashion until tetany is reached. Plyometric training conditions the neurons to contract with a single powerful surge rather than several disorganized contractions. The result is a stronger, faster contraction allowing a heavy load (such as the body) to be moved quickly and forcefully.

Repeated use of plyometric exercises will gradually increase the efficiency of neuromuscular connections between brain and muscle. However, a fine balance must be used, if one wishes to build strength and power through plyometrics. It is often recommended that plyometric repetitions be no higher than 75-100 repetitions. Also, training with plyometric exercises more than three or four times per week can cause muscular degeneration, if proper nutrition and rest are not taken into account.

Plyometrics have been shown to have benefits for reducing lower-extremity injuries in team sports while combined with other neuromuscular training (i.e.

strength training, balance training and stretching). Plyometric exercises involve an increased risk of injury due to the large forces generated during the training and performance, and should only be performed by well-conditioned individuals who are under supervision. Good levels of physical strength, flexibility, and proprioception should be achieved before the commencement of plyometric training.

The specified minimum strength requirement varies depending on where the information is sourced and the intensity of the plyometrics to be performed. **Chu (1998)** recommends that a participant should be able to perform 5 repetitions of the squat exercise at 60% of his bodyweight before doing plyometrics. Core body (trunk) strength is also important.

1.8.1 PLYOMETRIC INTENSITY

Intensity is the effort involved in performing a given task. In plyometrics, intensity is controlled by the type of exercise performed. Plyometrics ranges from simple tasks to highly complex and stressful exercises. An activity can be carried out with different intensities, which will have different effect on the organism. Thus, the exercise load must have some minimum intensity in order to get the same effect on the organism. With the improvement in training state, the effective zone of intensity shifts to higher level. The intensity of plyometric exercises can be increased by raising the platform height for depth jumps, or simply by aiming at covering a greater distance in longitudinal jumps. Thus, the intensity of the exercise which is performed without any equipment is automatically related to one's own body weight. These

types of exercises, if properly planned, are of more effective for improving the motor fitness components.

Examples of lower body plyometric exercises with intensity level: standing based jumps performed on the spot (low intensity) such as tuck jumps and split jumps.Jumps from standing (low-medium intensity) such as standing long jump, standing hop and standing jump for height. Multiple jumps from standing (medium intensity) like bounds, bunny hops, double footed over low hurdle and double footed jumps up steps. Multiple jumps with run in (high intensity) like 11 stride run + 2 hops and a jump into sandpit and 2 stride run in + bounds. Depth jumping (high-very high intensity) variations of jumps down and up off box (40 to 100 cm), bounding up hill and Eccentric drop and hold drills like hop and hold, bound/hop over 30 meters (athletes stop and hold on each landing before springing into the next move), drop and hold from a height greater than one meter.

1.8.2 PLYOMETRIC FREQUENCY

Frequency is the number of times an exercise is performed (repetitions) as well as the number of times an exercise session takes place during a training cycle. Recovery is a key variable in determining whether plyometrics will succeed in developing power or muscular endurance.

Shaver (1982) stated that Physical training with frequency of three to five days per week is an optimal number of workouts for developing fitness levels. Once a regular exercise has been established and the workouts have become enjoyable, then

the frequency of workouts may be extended to more than three to five days per week. It is important, however not only to initially start out training every day of the week, since chances are good that the individual after a couple of weeks, will become completely exhausted (mentally and physically), and will more than likely quit the programme. Since one of the major goals of an exercise programme is to make it not only intense enough to see some positive results, but also to make it enjoyable enough to become it as a part of an individual's routine life.

The frequency of the exercise sessions depends partly on the health and fitness level of the individual. Normal and sedentary individuals should exercise a minimum of three times a week to produce significant changes. As the fitness level increases, however the frequency should be increased to five times a week for continued improvement. It may be maintained by exercising two to four days a week, providing the intensity and duration of workouts are similar to that used to achieve the current fitness level.

1.8.3 CONCEPTS OF PLYOMETRIC TRAINING

Plyometrics are training techniques used by athletes and players in all types of sports to increase strength and explosiveness. Plyometrics consists of a rapid stretching of a muscle in eccentric action immediately followed by a concentric or shortening action of the same muscle and connective tissues. The stored elastic energy within the muscle is used to produce more force that can be provided by a concentric action alone. Researchers have shown that plyometric training can contribute to the improvement in vertical jump performance, acceleration, leg

strength, muscular power, increased joint awareness and overall proprioception. Plyometric drills usually involve stopping, starting and changing direction in an explosive manner. These movements are the components that can assist in developing agility. Agility is the ability to maintain or control body position which quickly changes the direction during a series of movements. Agility training is thought to be a re-enforcement of motor programming through neuromuscular conditioning and neural adaptation of muscle spindles, Golgi-tendon organs and joint proprioceptors. By enhancing balance and control of the body positions during movement, agility theoretically should improve.

Since the year 1960, coaches and scientists around the world have been searching for training means and measures to improve the storage and reuse of elastic energy in skeletal muscle during Stretch Shortening Cycle (SSC). The so called plyometric exercises can do that. They are defined as exercises that activate the stretch shortening cycle of skeletal muscles, including the elastic, reflex and mechanical potentiating. Several factors interfere with this potentiating, changing the capacity to generate positive work during SSC. Among them, the most important are the amplitude and speed of the eccentric phase, as well as the coupling time between the eccentric and concentric phases. The most favorable situation in track and field combine small amplitude with high speed in the eccentric phase and a short coupling time.

Plyometric exercises train the muscles to carry out effectively the SSC, which is a pattern of muscle contraction, involving in a stretch of the muscle followed immediately by an explosive contraction. Plyometric training is a method of

developing explosive power, and ultimately improving athletic performance. Plyometric exercises include jumps, hops, skips, bounds and throws. Although plyometric have long been practiced in athletic training and conditioning, the term did not appear in the literature until 1960's. Research has shown that the plyometric training in varied intensities can elicit greater performance and can improve maximal strength in athletes who have not previously participated in plyometric training.

Two considerations regarding training level are important when structuring a plyometric training programme: the intensity level of the exercise and the experience of the players. Plyometric training should be a progression of exercises and skilled movements that are considered to be elementary, intermediate and advanced in scope. Plyometric training is used for the lower body, upper body and core to enhance speed of movement in more specific skills. Plyometric training helps athletes learn greater balance, co-ordination, quickness, agility, speed and power.

Plyometric training can take many forms, including jump training for the lower extremities and medicine ball exercises for the upper extremities. Each jump training exercises were classified according to the relative demands they placed on the athlete. All the exercises are progressive in nature, with a range of low to high intensity in each type of exercise.

The classifications of exercises are jumps in place; standing jumps; multiple hops and jumps, bounding, box drills and depth jumps. Age, experience and athletic maturity are all important criteria in establishing and modifying plyometric training. Plyometric training can be adapted to virtually every sport, and athletes should do exercises that help to enhance the movements they perform. By mimicking certain

movements in plyometric training, athletes can decrease movement time and become more powerful.

Plyometric training should be considered in the context of the athlete's age, skill levels, injury history, and a myriad of other variables that comprise his or her athletic development. In this way through applied research, practitioners can learn to establish realistic expectations.

1.8.4 TYPES OF PLYOMETRIC EXERCISES

A systematic and progressive plyometric training programme is a vital component of any integrated training programme. As plyometric training is one of the more advanced training tools, the athlete needs proper levels of flexibility, core strength, and balance before progressing into plyometric training. Sports Performance Professionals must follow very specific program guideline, proper exercise selection criteria, and detailed program variables for the best outcome and lowest risk of injury.

As with all training programs, overload will need to be considered with plyometrics. Increasing the stretch load increases intensity. This can be accomplished by using body weight over a greater jump distance or drop height. Progressing from two-legged to one-legged jumps also increases intensity. As the athlete progresses, the duration of the amortization phase should be as brief as possible. The number of foot contacts monitors training volume; the more contacts, the greater the training volume. As always, training volume is inversely related to training intensity. **Potach and Chu (2000)** offer the following suggestions for a single training session: low-intensity training – 400 foot contacts; medium-intensity training – 350 foot

contacts; high-intensity training – 300 foot contacts; very-high-intensity training – 200 foot contacts. Experience should also be considered when prescribing plyometrics. Athletes with minimal experience using plyometrics should keep the ground contacts to less than 100 maximal efforts per session, whereas those with considerable experience could have as many as 120–140 maximal effort ground contacts per session.

The Optimum Performance Training model provides a systematic, progressive and integrated plyometric training programme to safely and effectively progress an athlete through this portion of their programme.

1.8.5 PLYOMETRIC STABILIZATION EXERCISES

Plyometric exercises are designed to establish optimum landing mechanics, postural alignment and reactive neuromuscular efficiency. Exercises in the stabilization level of plyometric training involve little joint motion. Upon landing, the athlete should hold the landing position (or stabilize) for 3–5 seconds before repeating.

PLYOMETRIC-STRENGTH EXERCISES

Plyometric exercises are designed to improve dynamic joint stabilization, eccentric strength, rate of force production and neuromuscular efficiency of the entire human movement system. These exercises are performed in a more repetitive fashion by spending a shorter amount of time on the ground.

In the strength level of plyometric training, exercises are more dynamic, requiring eccentric and concentric movement throughout the full range of motion. The specificity, speed and neural demands are also progressed within this level. Exercises in this level can also be performed in all three planes of motion.

1.8.6 PLYOMETRIC POWER EXERCISES

Plyometric exercises are performed as fast and as explosively as possible. In the power level of plyometric training, exercises involve the entire spectrum of muscle actions and contraction velocities important for integrated, functional movement. These exercises are designed to improve the rate of force production, eccentric strength, reactive strength, reactive joint stabilization, dynamic neuromuscular efficiency, and optimum force production.

1.8.7 UPPER BODY PLYOMETRIC EXERCISES

When one hears the word plyometrics, the first thought that comes to mind is some type of jumping movements: for example, on hand off boxes of various heights. Plyometric exercises take advantages of a phenomenon known as the stretch-shortening cycle (SSC).

In brief, when a muscle is stretched very rapidly in an eccentric fashion, immediately prior to a concentric shortening (rebounds), stored elastic energy and neural mechanisms cause the resultant concentric contraction, to be more forceful than, if the rapid stretching of the muscle not occur.The SSC phenomenon can be seen

in a vertical jump test. A person performing a vertical jump test will always achieve a higher jump with a preceding counter movement.

Plyometrics are often performed as a shock method to increase power and explosiveness. For example, jumpers in track and field often employ lower body plyometric exercise in order to increase their power capabilities which are crucial to success in jumping. However, plyometric exercises for the upper body receive less attention. Certainly, the performance of many athletes would benefit from implementing upper body plyometric training into their routine **(Joseph *et al*. 2007).** Press ups and hand clap: Press-ups with a hand clap in between is a particularly vigorous way to condition the arms and chest. The pre-stretch takes place as the hands arrive back on the ground and the chest sinks and this is followed quickly by the explosive upward action. Once again, to get the best training effect, the time should be kept in contact with the ground to a maximum. Medicine Ball: Another means of increasing upper body strength popular with throwers is to lie on the ground face up. A partner then drops a medicine ball down towards the chest of the athlete, who catches the ball (pre-stretch) and immediately throws it back. This is another high-intensity exercise and should only be used after some basic conditioning.

Plyometric training enables an athlete to apply more force in a shorter time span. This increases the performance in the split instant he has to perform in field situation. It is one of the most effective methods of increasing power in an athlete which is extremely important in modern sport. The most beneficial plyometric training should follow a phase of maximal strength training. The more the maximal

strength of an athlete, the more it can be used for generating power in his body for his chosen sport through plyometric training.

Certain sports require upper body plyometric training like the throwing events in athletics, basketball, volleyball, football, softball, golf, baseball, tennis and badminton. These kinds of exercises generally make use of a medicine ball. There are both low and high intensity plyometric exercises. Skipping is a low intensity exercise for example and reactive drop jumps are of the high intensity variety. A programme should move from low intensity to high intensity drills especially for beginners to this variety of training. A proper warm up is necessary for all plyometric exercise programmes. This can be through jogging which may be either straight legged or toe based. Without a proper warm up, the pressure of plyometric exercise may cause damage to the body. Proper rest intervals between repetitions and depth jumps are required to ensure proper recovery of the muscles as well. Balance is also a major factor in the proper and safe performance of plyometric exercises.

1.8.8 LOWER BODY PLYOMETRIC EXERCISES

Plyometric exercises involve an increased risk of injury due to the large forces generated during training and performance, and should only be performed by well-conditioned individuals who are under supervision. Good levels of physical strength, flexibility and proprioception should be achieved before the commencement of plyometric training. The specified minimum strength requirement varies depending on where the information is sourced and the intensity of the plyometrics to be performed**.** Flexibility is required both for injury prevention and to enhance the effect

of the stretch shortening cycle. Proprioception is an important component of balance, coordination and agility, which are also required for safe performance of plyometric exercise.

The drop jumping exercise involves the athlete dropping (not jumping) to the ground from a raised platform or box, and then immediately jumping up. The drop down gives the pre-stretch to the leg muscles and the vigorous drive upwards, the secondary concentric contraction. The exercise will be more effective, the shorter the time the feet are in contact with the ground. The loading in this exercise is governed by the height of the drop that should be in the region of 30 to 80 cm. Drop jumping is a relatively high impact form of plyometric training and would normally be introduced after the athlete becomes accustomed to lower impact alternatives, such as two-footed jumping on the spot.

The bounding and hurdling exercise with forward motion is more effective in the name of the game. This is a form of plyometric training, where over sized strides are used in the running action and extra time spent in the air. Two-legged bounds reduce the impact to be endured, but to increase the intensity, one legged bounding, or hopping, can be used. Bounding upstairs is a useful way to work on both the vertical and horizontal aspects of the running action. Multiple jumps over a series of obstacles like hurdles are valuable drills for athletes training for sprinting or jumping events.

1.8.9 PHYSIOLOGICAL PRINCIPLES OF PLYOMETRIC TRAINING

Plyometric training utilizes the elastic and proprioceptive properties of a muscle to generate maximum force production **(Wilk *etal.,* 1993).**

Voight and Wieder (1991) By stimulating mechanoreceptors to facilitate an increase in muscle recruitment in a minimal amount of time. Muscle spindles and Golgi Tendon Organs (GTOs) provide the proprioceptive basis for plyometric training. The central nervous system then uses this sensory information to influence muscle tone, motor execution and kinesthetic awareness **(Lundin, 1985).** Stimulation of these receptors can cause facilitation, inhibition and modulation of both agonist and antagonist muscle activity. This enhances neuromuscular efficiency and functional strength **(Astrand, 2003; Jacobson, 1670; O'Connell, Gardner, 1972; Schmidt, 1982; Swash and Fox, 1972).**

The concept of plyometrics is based on the three-component model of muscle. Muscle is modeled with a contractile element and two elastic elements that are named according to their relationship to the contractile element—one in line with (the series elastic element) and one in parallel (the parallel elastic element). When a muscle contracts, tension is not directly transmitted to the ends of the tendon and the load is not overcome, leading to movement. This would only happen if the connection between the contractile element and its insertion were rigid and inelastic. In reality, the contractile element develops tension, stretching the series elastic element; the degree of stretch is dependent on the load to be moved. After sufficient tension has been generated the tension at the ends of the muscle is sufficient to overcome the load and the load is moved.

When a load is applied to a joint (eccentric phase), the elastic elements stretch and store potential energy (amortization phase) prior to the contractile element

contracting (concentric phase). An eccentric contraction immediately preceding a concentric contraction significantly increases the force generated concentrically as a result of the storage of elastic potential energy **(Bosco *et al.* 1982)**.

During the loading of the muscle, the load is transferred to the series elastic components and stored as elastic potential energy. The elastic elements then contribute to the overall force production by converting the stored elastic potential energy to kinetic energy, which enhances the contraction **(Asmussen *et al.* 1974)**. The muscle's ability to use the stored elastic potential energy is affected by the variables of time, magnitude of stretch and velocity of stretch. Increased force generation during the concentric contraction is the most effective when the preceding eccentric contraction is of short range and is performed without delay **(Wilson *et al.* 1991)**.

A simple example of the use of the energy stored in the elastic element is the basic vertical or counter movement jump. The initial squat (the counter movement) is the eccentric phase that stretches the elastic elements and stores elastic energy (amortization phase). When the jump is performed (the concentric phase), the stored energy is "added" to the tension produced, leading to a higher jump. The amount of stored energy used is inversely proportional to the time spent in the amortization phase. When doing a vertical jump, the longer one waits at the end of the counter movement before performing the jump, the lower the eventual jump height due to the inability to recover the stored elastic energy.

The improved muscular performance that occurs with the pre-stretch in a muscle is the result of the combined effects of both the storage of elastic potential energy and the proprioceptive properties of the muscle. The percentage that each

component contributes is unknown at this time, but the degree of muscular performance, as stated earlier, is dependent upon the time in transition from the eccentric to the concentric contraction. Training that enhances neuromuscular efficiency decreases the time between the eccentric and concentric contraction, thereby, improving performance. This can be accomplished through integrated training.

1.9 REASON FOR SELECTING THE STUDY

Nowadays the life style of Indian college men has become more sedentary. It leads to overweight and obese, which plays a significant role for health hazards in future. Hence, the college men are in need of different types of training to increase their physical and physiological fitness. The future of the present study lay in providing new training programme for college men. Though several studies have been conducted on college men with plyometric training, no study has been conducted to find out the effects of plyometric training and Pilates training over college men. In order to find out the influence of plyometric training and Pilates training on motor fitness, physiological and psychological variables of college men, the investigator selected this study.

1.10 OBJECTIVES OF THE PROBLEM

The following objectives were made to fulfill the purpose of the study.

1. To find out the effect of Pilates training on physical, physiological and psychological variables of college men.

2. To assess the effect of plyometric training on physical, physiological and psychological variables of college men.
3. To assess the effect of combination of Pilates training and plyometric training on physical, physiological and psychological variables of college men.
4. To find out the best training outcomes among the training protocols for the obese college men.
5. To analyze, whether the Pilates training and plyometric training are suitable modes to get desirable result over the obese college men.
6. To create awareness on Pilates training among the college men.

1.11 STATEMENT OF THE PROBLEM

The primary purpose of the study was to find out the effects of pilates training and plyometric training on physical, physiological and psychological variables among college men.

The secondary purpose of this study was to find out the combination effect of Pilates and plyometric training on physical,physiological and psychological variables of college men.

1.12 HYPOTHESES

It has been widely accepted that pilates training helps in the precaution of hypo kinetic disease, in maximum development of intellectual capacity and in full enjoyment of life although the Pilates training has a positive influence on health a high level of fitness related training has a greater influence.

Based on the concept the following hypothesis have been formulated.,

1. It was hypothesized that there would be significant changes in motor fitness, physiological and psychological variables of college men by practicing Pilates training.
2. It was also hypothesized that plyometric training would produce significant changes in motor fitness, physiological and psychological variables of college men.
3. Further, it was hypothesized that the combination of Pilates and plyometric training would produce significant changes over motor fitness, physiological and psychological variables of college men.
4. Further, it was also hypothesized that that the Pilates training, plyometric training and combination of pilates training and plyometric training would produce similar results over the motor fitness, physiological and psychological variables of college men.

1.13 SIGNIFICANCE OF THE STUDY

The findings of the study will be of significance in the following way

1. The results of this study provide knowledge about physical, physiological and psychological limitations of college men.
2. The findings of this study would also helpful to design training programme with incorporating Pilates and plyometric training for the college men.

3. The research would be of great importance, if it is proved to be beneficial and it provides opportunities for the college mento design new training programmes.
4. The findings of the study may add to the existing source of knowledge with regard to Pilates and plyometric training to improve physical, physiological and psychological variables of college men.
5. The research would help us to compare the change that occurs in the selected variables before and after performing Pilates and plyometric training.
6. The contribution of the study would bring healthy fit society in India.
7. The study may help the future scholar to select the program related to the study.
8. This study may help the policy makers in physical education and youth welfare and health system of our country.

1.14 DELIMITATIONS

1. The study was conducted on 120 college men.
2. The age of the subjects ranged from 18 to 21 years.
3. The total period of the training was fixed as 12 weeks and training given 5 days in a week at morning session only.
4. The following variables were selected for the purpose of the study

Dependent variables

Motor fitness variables

1. Speed
2. Flexibility
3. Agility
4. Muscular strength endurance

Physiological variables

5. Resting pulse rate
6. VO_2 max
7. Anaerobic power
8. Breath holding time

Psychological variables

9. Stress
10. Anxiety
11. Aggression
12. Mood state

Independent variables

1. Pilates training
2. Plyometric training
3. Combination of pilates training and plyometric training

1.15 LIMITATIONS

1. Factors like heredity, environment conditions, lifestyle, food habits were not considered which might influence the motor fitness, physiological and psychological variables.
2. Socio-economic status was not taken into consideration.
3. The subject's academic standards were not considered.
4. The subject's previous experience in physical activities was also not taken into consideration.

1.16 DEFINITION OF THE TECHNICAL TERMS

SPORTS TRAINING

Sports training is the basic form of preparation of sportsmen

(**Matwejew, 1981**)

Speed

Speed as the rate of which a person can propel his body or part of his body through space. Otherwise speed is easily defined as the rate of motion or the velocity of the body or any one of its parts. **(Johnson and nelson, 1970)**

Agility

Agility as the physical ability, which enables an individual to rapidly change body position and direction in a precise manner.Otherwise agility is the ability to decelerate, accelerate and change direction quickly while maintaining good body control without decreasing speed. **(Singh, 1984)**

Flexibility

Flexibility is the ability to execute a wide range of movement in the joints while for repetition of work done in natural speed. **(Harold, 1990)**

Muscular strength endurance

Ability to overcome the resistance or act against the resistance in a single muscular contraction(Sing, 1984)

Resting Pulse Rate

The pulse rate is a wave of increased pressure which is felt at the arteries when blood is pumped out of the heart. It is not the blood pumped by the heart into the aorta that is felt, but the pressure transmitted from the aorta which travels more rapidly than blood.**(Pearce, 1997)**

Vo_2 max

Vo_2 max is the maximal oxygen uptake or maximum, volume of oxygen that can be utilized in one minute during maximal or exhaustive exercise. It is measured as milliliters of oxygen used in one minute per kilogram of body weight **(Quinn,2007)**

Anaerobic Power

Anaerobic means the absence of oxygen. anaerobic power is strongly related to explosive movements. The amount of work performed using performed using primarily anaerobic every systems.

Breath Holding Time

Breath holding time is defined as how long a person can pause his breath without stress **(Buteyko,1969)**

Mood State

Mood state refers to a person's experience of emotion, the way the person feels 'inside'. Some examples of emotions are depression, elation, anger and anxiety. **(Halgin and Whitbourne, 2007)**

Stress

Stress is associated with a mental/ emotional/ physical state produced within an organism in response to a stimulus (whether internal or external) that is perceived as a threat stressor. (**Selye 1956**).

Anxiety

Anxiety is a multisystem response to a perceived threat or danger. It reflects a combination of biochemical changes in the body, the patient's personal history and memory, and the social situation. **(Gabriele *et al.* 2004)**

Aggression

Aggression is any behavior intended to hurt someone, either physically or verbally. **(Weiten and Lloyd, 2007)**