Chapter 1

Sports Training-An Introduction

The word 'training', in its broad sense, refers to any organized and systematic instructional process, which aims at enhancing man's ability with regard to physical, psychological and intellectual aspects. In the field of sports, training is a process, which involves preparation of a sportsperson to attain highest level of sports performance. To improve sports performance, one has to, regularly and systematically, perform a variety of exercises. Mere execution of an exercise does not ensure improvement of performance. Actual effect of exercise depends upon several factors of which the important ones are training load, means of recovery, assessment of loading and performance capacity, sports equipment, nutrition, psychological characteristics and methods adopted for imparting theoretical instruction. If these factors are disregarded, the usefulness of the physical exercise decreases and the sportsperson does not realize optimal benefit.

Ward and Watts (1977), the two leading British track and field coaches in their book entitled 'Athletics for Student and Coach' wrote, 'the task of the coach is to help the athlete to achieve excellence'. They have said that sportsperson is the focus of attention; their quest for excellence, whether in an individual or a team sport, is the reason why they commit their talent to a coach. Basically, the coach offers knowledge and time to athletes, and assists them to enhance their skills and fulfill their potential in return for the satisfaction gained from helping others. In this process the coach may receive monetary rewards and/or recognition but the underlying the effective role of the coach is the earnest desire to assist others achieve their potential in sport

whether individually or as a member of a team. The relationship between coach and sportspersons is an important one-the sportsperson has the talent and the desire to develop it; the coach has the knowledge and skill to develop that talent. The relationship is one of mutual respect and interdependence.

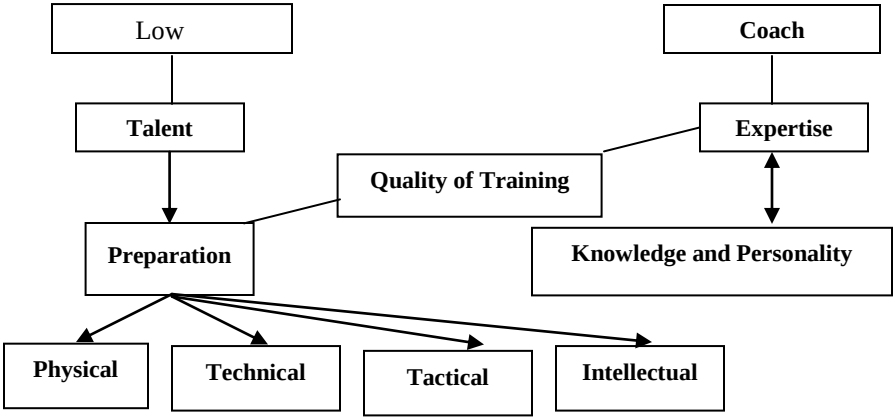


Fig. 1. The relationship between sportspersons and coach.

This complex nature of sports training, in order to be effective and beneficial, requires knowledge and assistance from other sports science disciplines e.g. sports medicine, exercise and sports physiology, sports sociology, sports psychology, sports bio-mechanics, sports nutrition, sports biochemistry and so no. As the performance of a sportsperson improves, the extent of utilization of knowledge from these sports sciences also increases.

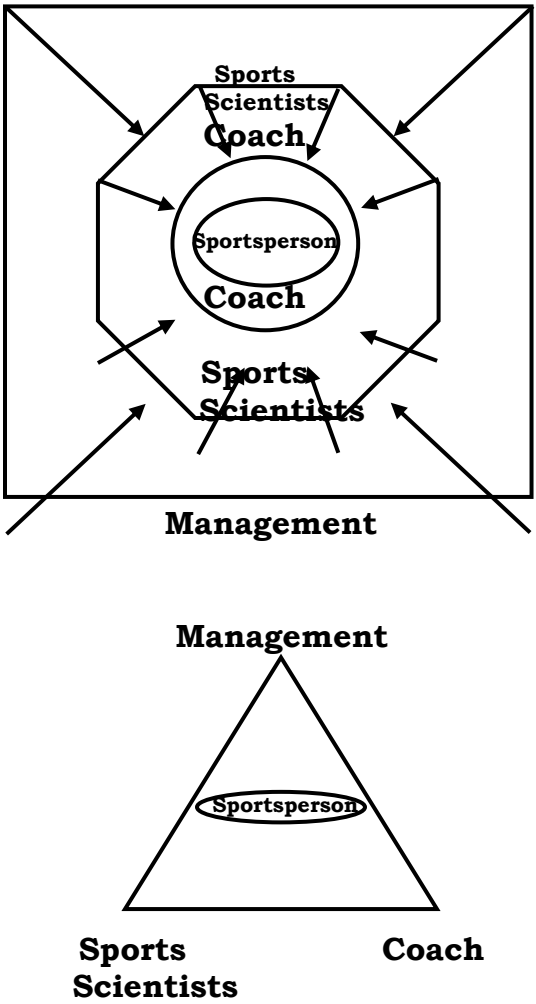


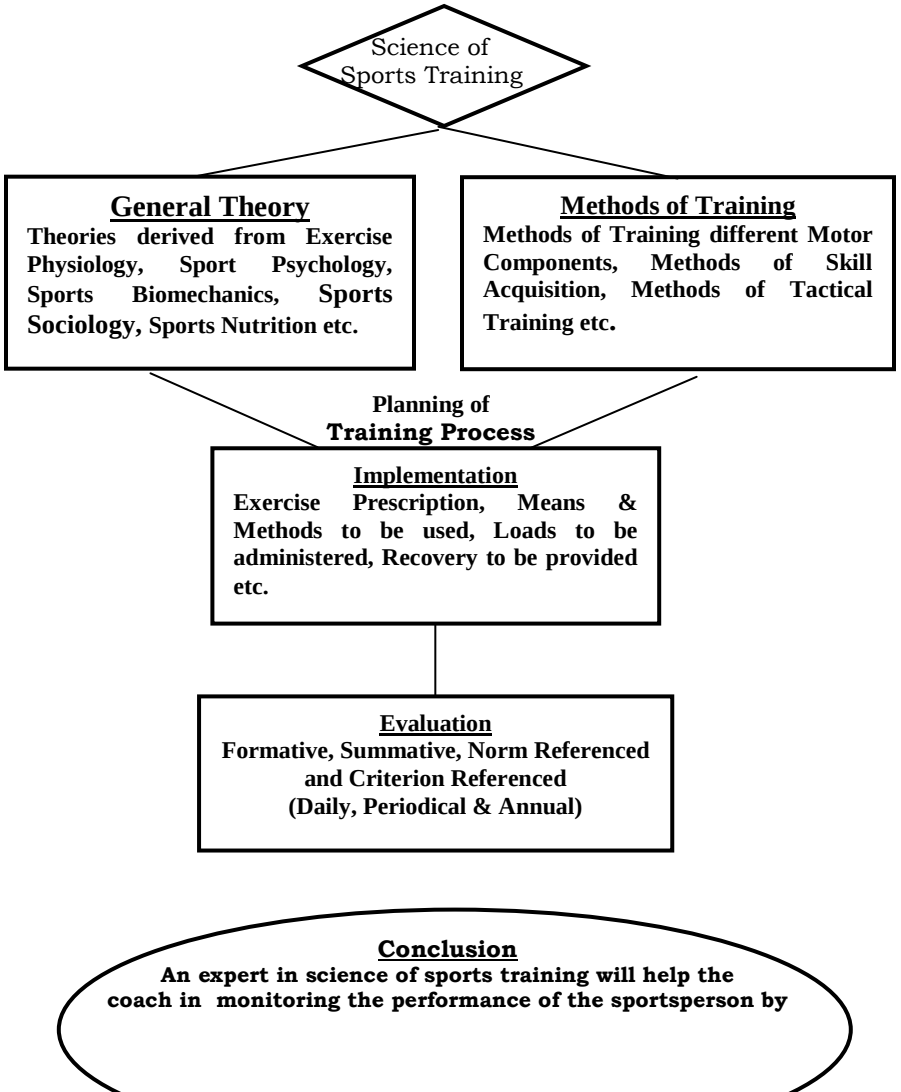
Fig. 1. Support Structure in Sports Training

In both the above diagrams (Fig.1& 2), the sportsperson is the nucleus and receives all possible support from the coach with whom he maintains a

direct contact and who scientifically monitors the training process. Others who help the sportsperson in attaining the highest possible performance is the group of sports scientists belonging to different disciplines who carry out periodic evaluations, identify the gray areas and provide regular feedback so that the coach may incorporate their suggestions in the training programme and guarantee enhancement of performance. Support in the form of management comes from the parents, teachers, friends and colleagues. The support provided by the coaches, sports scientists and others (management) is some how linked. In case the link breaks at any point, the person who suffers is the sportsperson. Therefore, a very good coordination must exist between the coaches, sports scientists and management so that the sportsperson receives the needed help to enable him/her to attain the aim of sports training.

An expert in Science of Sports Training will help the coach to work out long and short-term training programmes. The help of the coach in bifurcating the training process into training periods and phases and their further sub-division into training cycles namely macro, meso and micro cycles will be of immense benefit for the sportsperson. He will assist in ascertaining target-training zones so as to correctly administer training loads as per the ability of a sportsperson in order to make the load effective. A coach has to formulate the training programme keeping in mind certain individualistic characteristics namely biological chronological and training ages; training state; talent; psychological factors like personality; intelligence; temperament; social and economical factors; total load taking capacity and possibility to recover. Adherence to these principles only would ensure maximum benefit for the sportsperson. He will

also help in working out load-recovery ratio. A scientifically worked out training load in terms of load intensity and load volume would be ineffective for a spotsperson in case the recovery provided is not in proportion to the load administered. The coach has to ensure that the training of his sportsperson is uninterrupted and the training load is steadily increased as soon as the sportsperson gets adapted to the load.



providing scientific inputs based on his evaluation. He will act as a bridge between a particular sports discipline and different sports science experts. Based on the results of laboratory testing, he would interpret the results and translate the same to the coach as well as the sportsperson

Fig. 2. Structure of Science of Sports Training

Sports training is a systematic process extending over number of days and even months and years. In the course of training, in addition to application of physical load through physical exercise, theoretical instructions are also imparted so as to provide necessary technical and tactical knowledge and intellectual development.

Sports training aims at improving sports performance through physical, physiological, psychological, social, intellectual and moral aspects thus contributing to development of all-round personality of the sportsperson. In other words the performance of a sportsperson improves as a result of development of total personality. Therefore, since sports training directly or indirectly focuses attention on development of all-round personality of a sportsperson, sports training is an educational (pedagogical) process.

In order to have a clear concept of the word 'sports training' it is also essential to understand the meaning of the terms conditioning and coaching. Conditioning is a process of gradually preparing the body for strenuous physical activity thus focusing attention on development of physical and motor fitness components (strength, speed, endurance, flexibility, co-ordinative abilities) and indirectly enhancing sports performance.

In general sense the term 'coaching' refers to providing help so that a person can execute his job efficiently. As applied to sports, the term 'coaching' may

be described as a technical skill which involves co-ordination of factors like time sequence, action movement and speed so as to enable a sportsperson to attain highest level of efficiency in a specific sport. According to Martens, coaching involves teaching, training, instructing and helping people to learn skills of games and sports, improve performance and reach their potential. It is also about recognizing, understanding and providing for the social, emotional and personal needs of the sportspersons.

Sportspersons are made capable of competing efficiently at national and international levels only when they are given full scientific knowledge about the sports by way of acquiring complete physical preparation, technical mastery and tactical efficiency in addition to development of psychological characteristics important to a specific sport. But all this is not possible without perfect coaching.

Definition of Sports Training

Sports training is a process of sports perfection directed by scientific and pedagogic principles and aims at leading a sportsperson to high and top level performance in a sport on an event by means of planned and systematic improvement of performance capacity and readiness of performance.

Aim and Tasks of Sports Training

The aim of sports training is to prepare a sportsperson physically, physiologically and psychologically for a possible highest sports performance at the time of main competition, in a specific sport. In order to make a sportsperson capable of putting up optimal performance, systematic

improvement of performance capacity and readiness of performances is to be carried out. To ensure this, the following four tasks are to be achieved.

1.Physical Preparation

Complete physical preparation of a sportsperson is ensured as a result of development of essential motor qualities namely strength, endurance, speed, flexibility and co-ordinative abilities. Through training, these motor qualities can be developed separately as well as in combination with each other. These qualities are a pre-requisite for good performance in sports. Therefore, adequate time should be spent so as to train these motor abilities to optimal level. The requirement of these abilities differs from sport to sport. To train these motor qualities, the sportspersons have to regularly participate in general, specific and competitive exercise schedules, which are specific to a sport.

2.Technical Preparation

The level of skill attainment of a sportsperson has a direct relation to sports performance. Higher the level of skill, higher will be the performance. In order to acquire skill mastery, one has to undergo technical training. Through technical training the skills are to be stabilized so that during the pressure of competition they do not get adversely affected. Complete technical mastery also ensures economic application of motor abilities during competition thus reducing effort and energy. For good performance, motor abilities become meaningful only if skills of a sport are also mastered.

3.Tactical preparation

Tactics means intelligent or creative application of skills during a competition. Knowledge of competition rules, training of tactical concepts and acquiring of tactical skills are essential pre-requisites for complete

tactical preparation. Importance of tactics varies form sport to sport. Tactics plays more important role in the team games and in individual sports its role is limited. As the performance improves, the quantum of tactical training also increases.

4.Intellectual preparation

Intellectual preparation of a sportsperson in done through imparting scientific knowledge of theory of sports training. The sportsperson is to be encouraged to study literature on modern training means and methods and also modern techniques. An urge has to be created in the sportsperson to continue training and also develop a positive attitude towards hard training.

Availability of sports talent, application of appropriate means and methods to identify talent and presence of technical persons who are aware of the scientific methodology to groom the talent are the important pre-requisites in case an Institution or a Country even thinks of having sports teams or sportspersons who can match the national and international standards. In order to win sheer talent is not enough. Talent alone contributes to about 30% performance and the remaining 70% comes from effective and well-organized scientific training. The famous adage 'catch them young and coach them right' supports the above view. Many potential children who had all the pre-requisites and the desire to become high performance sportspersons failed to attain heights solely because they had not been scientifically groomed. Since sports training has become very complex, a coach has to have a very sound knowledge of Science of Sports Training so that he is in a position to tackle varied problems confronted by sportspersons. The problems faced by players are diverse and unless the coach is

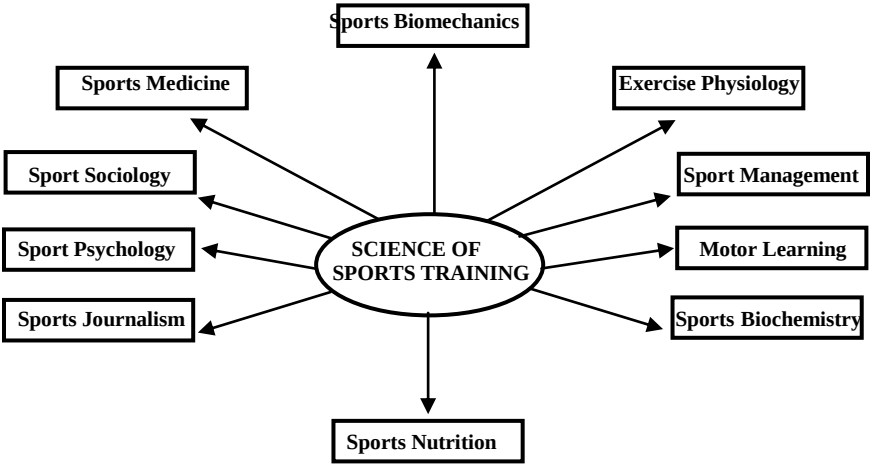
aware of the modern principles of sports training he would not be able to do justice with his position.

In view of the above, a very important task of the coach is to identify potential sportspersons. For this purpose he is to understand the scientific process of talent search as well as to get familiar with the scientific process underlying their proper grooming. The three steps for talent identification and their development are:

1. The first step is to locate children who are suitable for sports.
2. The second step, which comes after 2 to 3 years of training aims at finding out children who are talented for a group of sports.
3. The third step, which comes after about 2 to 3 years of training aims at identifying talent for a single sport or for one or two events.

A sound knowledge of Science of Sports Training comes very handy in the above process.

Relationship of science of sports training to other sports science disciplines



Science of sports training occupies a very significant place among all the sports science disciplines and functions as a bridge between different games and sports and various branches of sports science.

Importance of Sports Training

This important discipline of sports science deals with understanding, application and formulation of general principles of sports training as applicable to all games and sports as well as specific theory and methods of training applicable to a specific sport. Therefore, this important area of sports science has both, the general as well as the specific aspect.

1. In as much as sports training is an educational process, it contributes to development of personality of the sportspersons.
2. Sports training acts as a bridge between games and sports and different disciplines of sports science so that the coaches may derive maximum benefit from all sports science disciplines. In addition, it assists the coaches in designing the training process on the basis of the following training principles
   - i) Pedagogical principles
   - ii) Physiological principles
   - iii) Psychological principles
   - iv) Mechanical principles

3. It acts as a filter and interpreter for the exchange of knowledge between different games and sports and sports science and also helps in creating a positive environment where all the resource persons could work together for achieving the goal.
4. It helps in the development of theories and methods of sports training so that a constant rise in performance can be ensured.

5. It helps in planning and preparation of long and short term training programmes (Training schedules)

6. It assists in understanding the relative value of different components of motor fitness in enhancing performance in different games and sports and economizing the process of their development.
7. The knowledge of this discipline has helped in the selection of appropriate methods of improving different components of motor fitness commensurating with age and sex.
8. It helps in computation of target training zones and understanding the process of adaptation to training loads.
9. It helps in working out load-recovery ratio.
10. It assists in the periodization of training time and selection of appropriate type of periodization depending upon the nature and frequency of competition.
11. It helps in understanding the concept of skill acquisition and methods of skill training.
12. It helps in understanding of tactical concepts and their application during competition.
13. It contributes a great deal in the identification of talent.
14. It helps in pointing out the importance of competition in training and its role in enhancing performance.
15. It helps in the organization of training session.
16. To help in monitoring and evaluation of training process. and assists the coaches by way of examining all the training variables right from goal setting to achievement of result and help in re-designing the training plan at the earliest, if necessary. It also help the coaches in conducting specific laboratory test and their after interpret the results of the findings so as to translate the findings to the sportspersons. This process will help in ensuring better linkage between the coaches and the sports scientists.

Characteristics of Sports Training

1. Sports training is referred to individual high performance in a particular sport.
   In case a sportsperson has to keep pace at which the performance at national and international levels is improving, he cannot afford to focus attention on more than one game or sport. The training schedules are sport specific and in each training unit considerable amount of time is to be spent for training essential components of high performance related to a sport. However in track and field and swimming a sportsperson may train for more than one event especially where the pre-requisites of high performance are common.

2. Sports training in an individual process.
   It is an accepted fact that no two individuals are alike and their abilities and capacities vary. Sportspersons differ in age, training age, state of health, load-taking capacity, pace of recovery, type of constitution and nerves, and in several other factors, which influence training. In view of the above, the training load is to be prescribed for each sportsperson individually. The principle is that players of a team may train collectively as far as possible but undertake calculated loads individually, as necessary.

3. Sports training requires a sports life corresponding to the demands of competitive sport.
   The training programme of sportspersons shall be so designed that they learn to face the high demands of the competition. The sportspersons have to develop such characteristics that they adapt themselves quickly to competitive situations and are able to perform well.

4. Sports training is systematic and planned.
Systematically planned training programmes only can help a sportsperson to achieve high performance. Unsystematic, confusing and haphazardly planned training schedules will be detrimental to attainment of high standard of sports achievement.

5. Sports training is scientific.
Sports training programme are scientific in nature and they incorporate findings of the latest researches and reject training methods and means, which get out-dated. Sports training programmes should mirror latest trends and developments in the field of sports training so as to ensure attainment of optimum performance in sports.

6. Sports training calls for high degree of self-reliance on the part of the sportsperson.
The sports training programmes are designed in a way that each sportsperson develops self confidence and starts relying on one-self rather than depending on spoon feeding by the coach. The coach acts as a leader who guides and assists the sportsperson in achieving high performance.

7. Sports training is an educational process.
As a result of participation in systematically planned sports training programmes, the sportsperson develops an all-round personality and thus becomes capable of attaining high performance. In fact development of wholesome personality and improvement of sports performance are related to each other and are interdependent. Through regular participation in

properly supervised training schedules, the sportsperson learns to control emotions, learns the qualities of sportsmanship, learns to spend the leisure time in a worthwhile manner and also develops regularity, sincerity, hard work and positive attitude towards life.

Principles of Sports Training

Principles of sports training are the guiding factors for proper development and effective implementation of sports training. The coaches, physical educators and sportspersons have to adhere to these principles so as to have optimal benefit from the time and effort spent in training. The following principles of sports training should be kept in mind:

1. The Principle of Uninterrupted Training
   The sports training continues from day to day, week to week, month to month and from year to year. Interrupted training programmes do not guarantee attainment of high performance goals and thus lead to decline in performance capacity. Measured and calculated breaks in training are administered to ensure proper recovery but long breaks interfere with performance.

2. The Principle of Steadily Increasing Load
   The training load should be gradually increased in order to improve performance. Performance capacity of a sportsperson gets enhanced as a result of adaptation to training loads. If this process of increase in performance is to be kept as a continuous process, the training load needs to be increased as soon as the process of adaptation to load is complete. Repeating same load for a very long period causes a load to lose

its effectiveness. When a sportsperson continually undertakes same training load, there is an initial increase in performance, to a certain level and then the sportsperson remains at that level. Once the body has adapted to a particular training load adaptation ceases. Similarly, if the training loads are too far apart, the sportsperson's performance level would keep returning to original levels. Widely placed loading will produce little or no performance improvement.

3. The Principle of Individual Load

The training programmes need to be formulated keeping in mind certain individualistic characteristics namely biological and chronological age; training age; training state; talent, psychological factors like personality; intelligence; temperament, social and economical factors, total load taking capacity and possibility to recover. Adherence to this principle ensures maximum benefit to a sportsperson.

4. The Interval Principle

For the training load to be effective, every phase of load shall be followed by a measured period of recovery. Maximum adaptation occurs only when there is a proper proportion between phases of load and recovery. Phases of recovery, which are longer or shorter than what is actually needed in proportion to load administered, make the training loads ineffective.

5. The Principle of Active Participation

The performance of a sportsperson is the result of the combination of a sportsperson's efforts and the coach's skill. Unless the coach and sportsperson work together successful training

programme cannot be developed. In view of this the sportsperson shall also be active participant of the planning group entrusted with the responsibility of formulation of training programme. Sportsperson will be more sincere and meticulous in completing training schedules in each training unit when he himself actively participated in planning.

6. The Principle of Use of Critical Loads
In order to prepare a sportsperson to meet the unforeseen higher demands of competition, the training process shall include administration of critical load (loads which are higher than the loads normally administered) four to five times in a year. In order to ensure proper recovery the principle of proper proportion between phases of load and recovery shall be kept in mind.

7. The Principle of General and Special Preparation
This principle states that specific training loads produce specific response and adaptation. The training load must be specific to the individual sportsperson as well as to the demands of the sport for which one trains. In addition, in every training unit the sportsperson shall carry out both general as well as special preparation. General preparation creates a base over which special preparation can be done to enhance performance. General preparation shall always precede special preparation.

8. The Principle of Clarity
To enable a sportsperson to have optimal benefit from sports training programme, information about technique, tactics and other aspects of training performance shall be clearly given. The

training programmes will lose effectiveness if instructions are vague.

9. The Principle of Cyclic Process of Training

The time available for training is to be formulated in the form of training cycles of shorter and longer duration. During these cycles, the important features of outer training load are administered in a way that high performance results. The three popular cycles of training are:

i) Macro Cycle

The duration of this cycle is 3 to 12 months and thus is considered as the longest cycle of training.

ii) Meso Cycle

The duration of this cycle is 3 to 6 weeks and thus is considered as the training cycle of medium duration.

iii) Micro Cycle:

The duration of this cycle is 3 to 10 days and thus is considered as the training cycle of shortest duration.

In macro cycle, the last meso cycle; in the meso cycle, the last micro cycle; and in micro cycle, the last session of training are formulated to guarantee recovery and relaxation.

10. The Principle of Variety

In as much as sports training is a long term process, undertaking same load and recovery can lead to boredom for the sportsperson as well as the coach. Therefore in order to sustain interest and motivation the coach should include variety in the training programme. Variety in training can

be ensured by doing cross training i.e. participating in other sports, changing the nature of exercise, the environment, time of the day of session and the training group. This principle depends more on the creativeness of the coach.

11. The Principle of Reversibility
The supercompensation effect brought about by regular training is not permanent. In case there is a break in training, the adaptation process also breaks and the fitness level or the performance of a sportsperson returns slowly to the original level.

12. The Principle of Ensuring Results
The sports training programmes shall be so formulated that the attainment of training tasks is ensured. After spending time and effort, if a sportsperson fails to attain performance, he might start losing contact with training programmes and also lose confidence in the coach.

Systematization of Sports Training Process

The Systematization of training process of a sportsperson begins with the basic training and ends with the attainment of high performance. In view of the above, the following three levels of sportspersons are covered under this process.

1. Beginner
2. Advanced (Intermediate) level and
3. High Performance level

This process begins at the age of 10 to 12 years and continues until the achievement of performance comparable to national and international standards. Actual duration of training differs from sport to sport

and depends upon the nature of the activity. In speed dominated sports the total training process is shorter whereas in sports dominated by strength and endurance, sportsperson needs much longer period of training in order to attain optimal level of performance. Keeping in mind the above three categories of sportspersons, sports training at each level is classified as follows:

1. Basic Training
2. Advanced (Intermediate) level and
3. High Performance level

1. Basic Training

(a) It is a general long-term preparation of a sportsperson and in addition it also aim at development of qualities of character and will.

(b) Tasks to be fulfilled
   (i) Consolidation of health
   (ii) Development of basic physical abilities by means of many-sided physical training. All the motor qualities are to be equally developed.
   (iii) To develop rough form pertaining to skills of a sport or an event.
   (iv) To provide competitive experience so as to enable a sportsperson to learn how to react and behave in a competition.

(c) Content of training
   (i) A variety of training methods and means should be adopted so as to ensure all-round general development of athletic ability of a sportsperson.
   (ii) To select and perform exercises from other games and sports. A javelin thrower may

participate in volleyball and handball in view of similarity in the motor action and motor components to be developed.

(iii) Equal selection and application of exercises for development of different motor abilities.

(iv) The ratio between general and specific training means should be 70:30.

(d) Beginning and end of this stage:

Basic training is started at the age of 10 to 12 years and the duration of this stage is 3 to 4 years.

2. Advanced Training

(a) Aim

The qualities, which the sportsperson has developed during the basic training, are to be further developed and consolidated. The level of motor qualities and motor skills is to be improved. The qualities of character and will are to be adapted to higher motor abilities and skills. The requirements in training become higher in view of increase in the load of training. Participation in competition is to be increased. Sportsperson lays stress on the sport in which he is going to specialize.

(b) Tasks to be fulfilled

(i) Further consolidation and strengthening of health. In view of increased training load, the health is likely to be affected.

(ii) Further development of motor abilities by adopting training means of a specialized sport.

(iii) Development of technique up to final form.

(iv) Readiness to undertake risk.

(v) Development of self-reliance.

(c) Content of training

(i) General and specific training means and method are applied.

(ii) Training means of supplementary sports are applied in order to improve the motor qualities of a specialized sport.

(iii) The ratio between the general and specific training means should be 60:40 or 50:50.

(d) Beginning and end of this stage

The beginning of advanced training depends upon the performance reached by the sportsperson at the end of basic training and also on the rate of development of the physical and psychic qualities of the sportsperson. The duration of this phase of training is 2 to 4 years. The actual duration of this phase depends upon the performance reached by the sportsperson at the end of the training period. The sportsperson should attain average or even above average performance in the chosen sport.

3. High Performance Training

(a) Aim

To reach optimal performance standard in the chosen sport, which is comparable to national and international standards. The sportsperson should attain high performance efficiency at the time of national or international championship. The sportsperson should develop good behaviour and positive attitude so as to be a good example for the youngsters.

(b) Tasks to be fulfilled

(i) The motor qualities specific to the chosen sport are to be developed to optimal level.

(ii) The general condition is to be developed in accordance with the specific requirements of the chosen sport. The level of specific

qualities, to a great extent depends upon the general condition of the sportsperson.

(iii) The sports form should be developed in a way that it remains stable under the stress of competition.

(iv) The qualities of character and will must be accomplished under high competitive requirements.

(c) Content of training

(i) The selection and application of training methods and means depend upon the aim of high performance training and also on the individual characteristics of the sportsperson.

(ii) The ratio of general and specific training depends upon the chosen sport and also on the strong and weak point of the sportsperson. The ratio of 70:30 or 80:20 or 90:10 in favour of specific training is found suitable.

(d) Beginning and end of this stage

The beginning of the training period depends upon the performance reached in the chosen sport at the end of advanced training. The duration of this phase depends upon the rate at which the sportsperson develops and attain performance comparable to national and international standards.

Important Ingredients for Improving the Standard of Sports

In case a country decides to enhance the standard of sports, the following important ingredients are to be given due consideration:

1. Sportspersons: It is to be ensured that the sportspersons identified has the potential to

become a high sports performer. This can be ascertained by assessing the general motor ability of the selected individuals. In addition due consideration is also to be given to the coordinative abilities possessed by the sportsperson.

2. Coach: In as much as sports training has become a complex process, the coach must possess requisite knowledge and the technical skills to groom the talent of the selected potential sportspersons. In order to render the best possible help, he has to be abreast with latest trends and developments in the field of his specialization.

3. Teacher: Sports training is an educational process. Besides shaping a child as a sportsperson, due consideration is to be given to the academic performance. The emphasis should be on producing literate sportspersons. Intellectual development of the sportsperson is important to enable him to become a high sports performer.

4. Sports Scientists: The coach alone is not in a position to solve varied problems faced by the sportsperson. In view of this, depending upon the nature of problem, a team of sports science experts is needed to take care of different problems experienced by the sportspersons. The team of experts will comprise of exercise physiologist, sport psychologists, sports bio-mechanist, sports physician, sports sociologist, sports nutritionist, kinanthropomist and the like.

5. Organizers: A team of organizers is needed to look after varied aspects of high performance of the sportsperson. This may include managers, technical officials, trainers etc.

6. Friendly Family Towards Sports: Support of the parents and other family members goes a long ways in helping the sportspersons to attain high performance.

7. Policy: The country needs a policy, which would provide full support to the sportsperson. In the policy special provisions are to be made in order to eliminate all kinds of hurdles, which might interfere in his progress.

8. Equipment and Facilities: A proper sports infrastructure fitted with all modern facilities is needed for a sportsperson. Equipments with proper specifications are to be made available.

9. Finance: Availability of funds is a very important pre-requisite. Every thing needed by the sportsperson revolves around the funds.

10. Competitions: Sufficient number of competitions should be organized in order to see the extent to which the training has been helpful. In fact competition is a great motivating factor for a sportsperson because during the competition he would try to put up his best performance.

11. Support from Government: The government should provide wholehearted support to the sportspersons by way of providing funds, facilities, equipment etc.

12. Sponsors: Since government alone will not be able to meet the needs of the sportspersons, support from the sponsors would be of a great help to the sportspersons.

Chapter 2

Training Load

Of all the principles of sports training, the principle of training load and administering recovery in proportion to that is the most important and any mistake in adhering to this principle will prevent the sportsperson from attaining high performance. The training state of a sportsperson develops as a result of application of motor stimulus (movement) resulting in improvement and maintenance of performance capacity. In addition to improvement of performance, the training loads also facilitate maintenance and stabilization of performance capacity. Loads are also administered sometimes for the purpose of bringing about recovery and that is why the training loads are termed as fatigue producing and non-fatigue producing.

Sports training process involves activities and movements, which generally lead to fatigue. Fatigue is the direct product of load caused by physical activity or exercise. Fatigue is essential for improving the performance capacity of a sportsperson. Training load therefore is of central importance in sports training.

Definition of Training Load

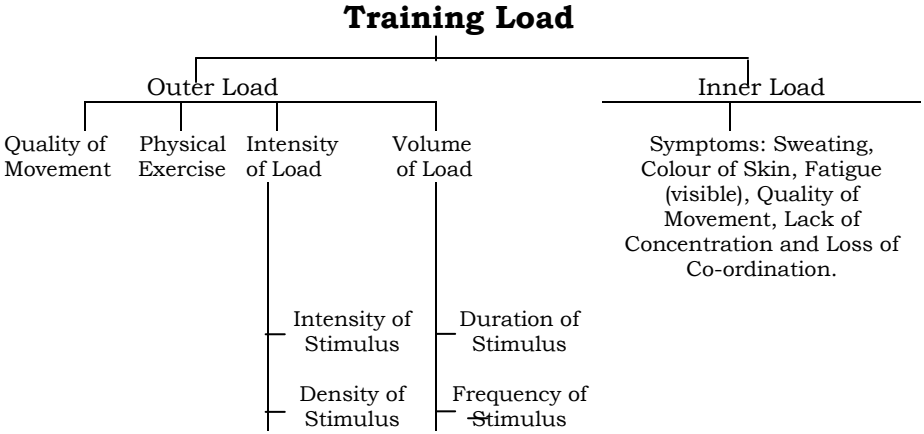
Physiological and psychological demands placed on the individual through motor stimulus (movement) resulting in improvement and maintenance of performance capacity.

The training load is of two types namely-

i) Outer load and
ii) Inner load

The following figure will provide a complete concept of various features of training load.

Factors of (Features) of Training Load



The outer load refers to type of physical exercise, quality of exercise execution, intensity of load (intensity and density) and volume of load (duration and frequency) of motor stimulus and the inner load is the reaction of the individual caused by these four load factors. .

1. Quality of Movement

   The quality of movement performed by a sportsperson has direct influence on training load. In the process of technical and tactical perfection, the quality of movement is an important factor of load. By enhancing the degree of difficulty of movement execution, the training load can be considerably increased. Since quality of movement is a subjective factor, its accurate measurement is difficult.

2. Physical Exercise

According to their effects; the physical exercise have been classified as general, special and competitive. They are considered as the most important means of training. Each exercise, depending upon the body parts involved, the co-ordination required and the opportunities used, produces a different type of load and hence different effect on performance capacity of a sportsperson.

3. Intensity of Load (Load Intensity)

It represents the degree of effort made by the sportsperson while performing an exercise. The degree of effort is always considered in relation to time and is equated with the amount of force or energy spent in relation to time. It is divided into intensity of stimulus (movement intensity) and density of stimulus (load density).

4. Volume of Load (Load Volume)

It is the total amount of work done while performing an exercise or in a training session. Volume of load can be classified into duration of stimulus (movement duration) and frequency of stimulus (movement frequency).

The intensity of stimulus can be described by speed in a cyclic exercise, amount of load during muscle strength exercise, the pace of bout or a game and frequency of movement (skipping). The intensity of stimulus is always expressed in percentage in relation to the maximum possible intensity (100%). Exercise with maximum intensity lead to development of speed, maximum strength, explosive strength and speed endurance whereas lower intensity facilitates active recovery.

The density of stimulus refers to the duration of recovery phases between two motor stimuli and sets of motor stimuli. It is also termed as the ratio between the phases of load and recovery.

The duration of stimulus represents time of influence of one stimulus or a set of stimuli e.g. lifting time in strength training exercise (weight training), distance run in a running activity (interval running). The frequency of stimulus is the number of times an exercise or a movement is repeated.

Components of Training Load and their Indices

Outer load
(Training Requirements)

Intensity of Stimulus	Density of Stimulus	Frequency of Stimulus	Duration of Stimulus
• Intensity of motor stimulus e.g. speed, distance, height, magnitude of resistance (kg) • Frequency of movement • Pace of a game • Pace of a bout	• Expresses the relationship of the effective time of loading and the total duration of training unit • Ratio between phase of load and phase of recovery	• Number of repetitions per set •Number of sets •Number of repetitions per training unit (all sets) •Number of loads for various muscle groups	• Duration of effect of one stimulus • Duration of one set of stimuli (weight training) • Duration of one phase of load (expressed by the distance in case of cyclic exercise) • Duration of the training unit • Training hours per year.

Components of Training Load, Effect and Correlation

Outer load

(Training Requirements)

Intensity of Stimulus	Density of Stimulus	Frequency of Stimulus	Duration of Stimulus
• Influences the pace of development and the stability of adaptation • When fixing the intensity of stimulus, take the following factors into consideration: - Functional and morphologic adaptations - Technical level - Tactical skills - Psychological condition - Health and functional state	• It is subordinate to intensity and duration of stimulus • It is determined by the task of the training session • Interval is longer incase the intensity stimulus is higher and the duration of stimulus is longer. • Optimum density of stimulus guarantees efficiency of loading and prevents premature exhaustion	• Depends upon intensity of stimulus • Depends upon duration of stimulus • Incase intensity and density of stimulus are higher, the frequency of stimulus is lower • Frequency of training per week for: Beginner: 3-5 Advanced: 6-8 Top level: 9-12	• Influences along with other components the effect of training on the sportsperson.

The training loads are termed as both fatigue producing as well as non-fatigue producing. The coach has to systematically monitor the four important features of outer training load namely intensity of stimulus, density of stimulus, duration of stimulus and frequency of stimulus so as to produce maximum training effect on the sportsperson. During the training

session, the coach has to look for the symptoms of inner load (sweating, colour of the skin, visible fatigue, loss of concentration, loss of coordination etc.). It is important for a coach to understand the role of the symptoms of inner load. The inner load not only helps to control the outer load but also plays an important role in determining the effectiveness of the training load. In addition it helps the coach in ascertaining whether his training load and recovery are in proper proportion. Limbering down is as important as warming up. Both these processes involve training load and these are non-fatigue producing. Warming up prepares the body for the ensuing physical activity whereas limbering down in done for accelerating recovery.

Principles of Intensity of Stimulus

1. Stimulus intensity less than 30% has no development effect.
2. In a cyclic endurance exercise, the speed should be such that it brings noteworthy effect on the heart and circulatory system.
3. Only high stimulus intensity creates supercompensation effect in sportspersons.
4. Load of work with high stimulus intensity causes rapid improvement but improved performance is less stable. Therefore, the training shall be extensive in nature. In this the performance improvement is slow but it is more stable.

Principles of Volume of Stimulus

1. The does of stimulus volume should be such that the sportsperson is able to perform to the best of his capacity in each training unit.
2. The does of stimulus volume should be such that visible symptoms of tiredness are seen.
3. Stimulus volume should be gradually increased even after having trained for a certain period.

4. Volume of training should always be in harmony with frequency of training.

Frequency of training depends upon the kind of sport, condition and training state of the sportsperson. With the increase in training age, the frequency of training shall be increased.

Training frequency for a beginner	3 to 5 training units per week
Training frequency for an intermediate level sportsperson	6 to 8 training units per week
Training frequency for a high performance sportsperson	8 to 12 training units per week

The training state of a sportsperson improves if he trains more frequently, provided the stimulus in terms of intensity and volume is effective.

Adaptation Process

In literal sense the word adaptation means to get adjusted with. The human organism possesses the ability to get adjusted (adapted) to the environment and as the environmental conditions change, the human organism also changes in the due course. This process of adaptation is also applicable to the field of sports training. The human organism changes to a new state of performance efficiency as a result of administration of external load. In fact load and adaptation go side by side.

This process of adaptation is a bio-chemical process and is applicable to improvement of conditional abilities (strength, speed endurance) only. As the

sportsperson is exposed to the training and competition demands, this results in disturbance of the homeostasis (internal body balance). The sportsperson makes and effort to restore the state of homeostasis by causing the different systems and bodily functions to adjust to the state of disturbance. In case the bodily homeostasis is disturbed again and again for a certain period of time than the human body responds by causing structural and metabolic changes, which enable the body to withstand the load more easily. This is called adaptation. As a result of training, the sportsperson also acquires technical mastery, but the process of acquiring skills is different from that of developing conditional abilities. In each training unit, the sportsperson performs different forms of physical exercises and these exercises put different demands on the sportsperson. All the physiological systems of the body work in a coordinated manner to cope-up with these demands. Efficient and smooth movements are facilitated by the contraction of muscles in a coordinated manner. For movement, energy is required which is released by the breakdown of energy substances. As the physical activity continues, the amount of energy substances decline. Enzymes and hormones are involved in the acceleration of energy liberation process and gradually get depleted. There is a wear and tear of muscle contractile substances and continuation of activity ultimately leads to fatigue.

During the recovery phase, all the substances, which were depleted, are restored. As a result of this, the performance level improves as compared to the pre-activity level. This is termed as supercompensation. This state of supercompensation is a temporary process and lasts for some hours after which it disappears and reappears again after few hours with a diminished level. This level of performance lasts for some time and again

disappears. It goes like a wave, which goes on diminishing until it finally vanishes. The first phase of supercompensation, when improvement is maximum needs to be consolidated and is the most favourable time for the next training load to be administered.

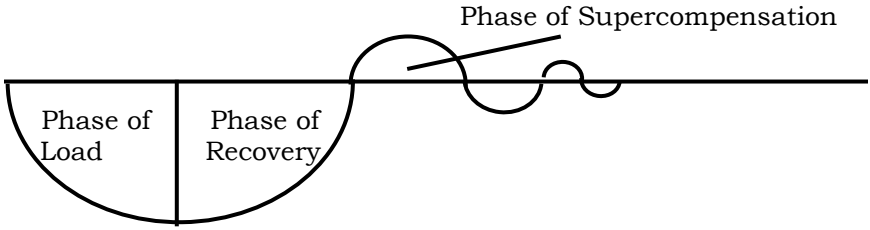
Therefore, the training load is to be administered regularly and repeated for 10 to 20 days for occurrence of stable adaptation so as to create a new level of proficiency. A training load, which has produced supercompensation effect, is termed as a standard load and a standard load cannot further improve the training state of the sportsperson. After the occurrence of supercompensation, the load should be increased during the next adaptation phase.

Complete technical and tactical mastery are important pre-requisites for a sportsperson. Unless the fundamental skills of a sport are learnt, physical and motor fitness alone would not help in putting up good sports performance. In view of this the coach has to understand the process of adaptation to training loads for the enhancement of conditional abilities namely strength, speed and endurance and as well as he has to develop a very clear concept regarding the process of skill acquisition. Both these processes enhance sports performance but they occur differently. Numerous training means and methods are available for the development of various motor components. The choice depends upon the age and training age of the sportsperson. A coach has to have a very clear concept about each of them. In order to acquire complete tactical mastery, the coach has to be well aware of different methods of tactical training.

For adaptation to training load the following three conditions are to be fulfilled.

1. Training load has to be as per the loading capacity of sportsperson.
2. Recovery period should be in proportion to the training load.
3. Loading and recovery process is to be repeated for a certain period of time (10 to 20 days).

Effect of one training schedule on performance



Effect of regular training on performance

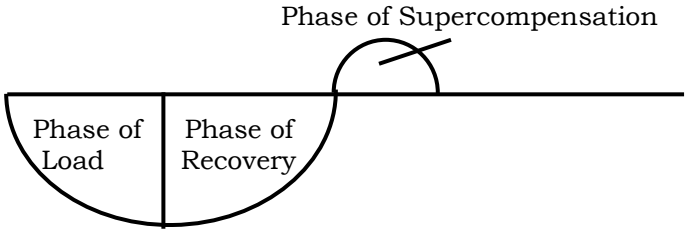
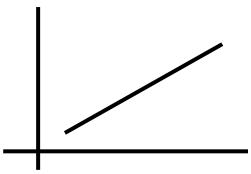
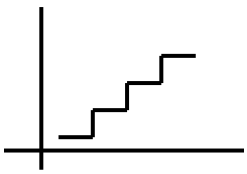


Fig. 3. Adaptation to training loads



Linear increase in load



Increasing load in the form of staircase

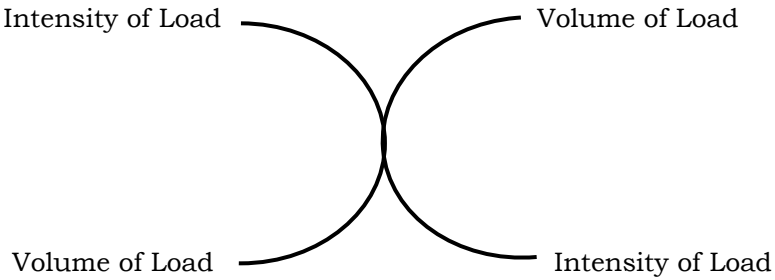
Fig.4. Procedure of increasing training load

The procedure of linear increasing in load is adopted only for 2 to 3 weeks as a part of basic training of a beginner. Thereafter the training load is increased in the form of staircase the method of increasing load in the form of staircase facilitates adaptation to training load before the training load is increased.

Conditions of Adaptation

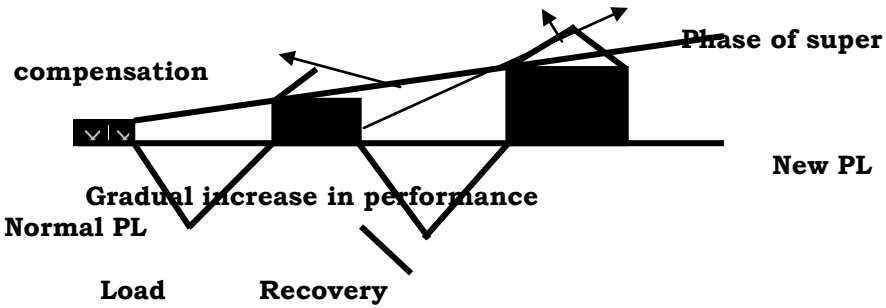
To ensure effectiveness of training load is each training unit, the following conditions of adaptation are to be strictly adhered to:

1. Adaptation is maximum when the training load is given on individual performance basis.
   To enable a sportsperson to have optimal benefit from training, the loads shall be administered keeping in mind the specific characteristic of an individual.
2. There should be a correct proportion between intensity and volume of training load.
   Intensity of stimulus has an inverse relationship with volume of stimulus.

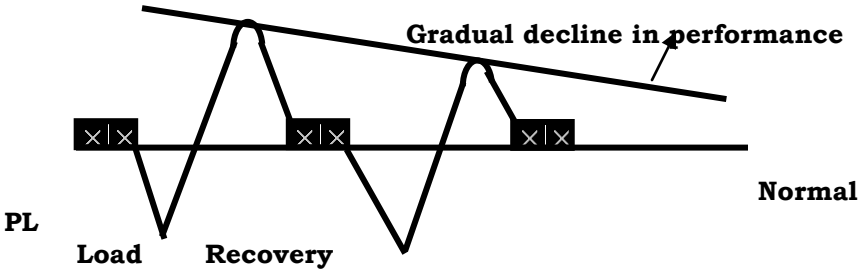


3. The adaptation process is the result of correct proportion between phases of load and recovery.
   The following diagrams (Fig.) illustrate the effect of training on performance under different conditions of proportion between phase of load and recovery.

LOAD RECOVERY RELATIONSHIP

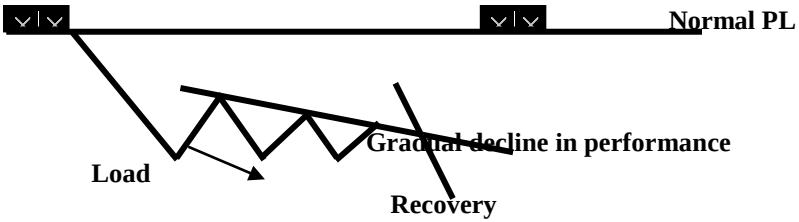


Proper relationship between phases of load and recovery



Improper relationship between load and recovery-longer recovery than required

Improper relationship between load and recovery-longer recovery than required



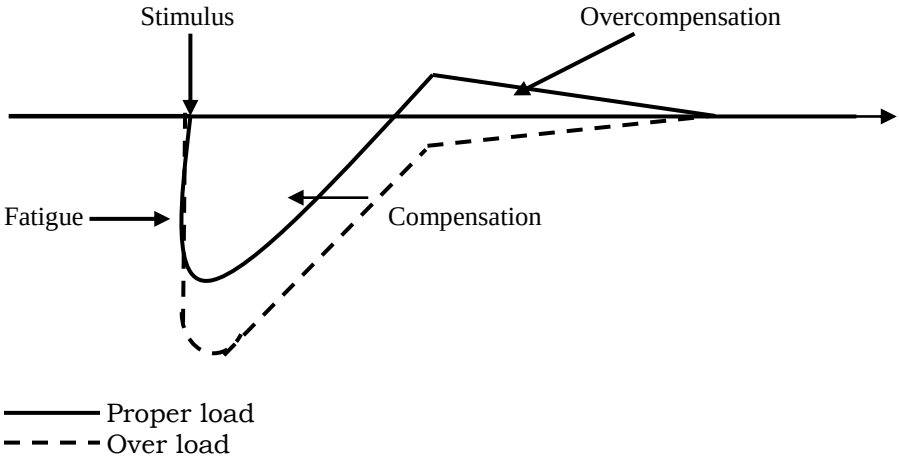
Improper relationship between load and recovery-very high load and short recovery

4. High load is essential for optimum adaptation.
   Training effect occurs only if the load is high enough to produce symptoms of fatigue. High load leads to high adaptation, medium load causes medium adaptation and low load brings about low adaptation.
5. For a beginner application of a new or an unfamiliar exercise or load creates a quick supercompensation effect.
   Adaptation process occurs faster in the case of beginners where as among high performance sportspersons, for adaptation to be complete, it may take much longer period. In order to avoid muscle memory, the exercises should be varied. If the same exercise or the sequence of exercises is repeatedly performed, their training effect reduces because they lead to muscle memory.
6. Long interval in training or reduction in training load breaks the adaptation process.
   Adaptation effect achieved as result of training is not permanent. The level of various conditional abilities declines if there is a long break in training. In view of this long transitional periods are not recommended.

OVER LOAD

The normal development of training state of a sportsperson is disturbed when the physical and psychic daily load of life exceeds the loading capacity of the individual. Over loads, administered over a longer period of time, lead to decreased performance capacity. Modern sports scientists consider the over loading phenomenon as disturbance in the normal nervous activity. Performance in sports is not only a matter of muscular on metabolic efficiency but it mainly depends

upon the efficiency of the nervous system. When nervous system gets disturbed, the optimum utilization of energy and metabolic process also gets disturbed. The other systems of the body are also unable to perform to the best of their efficiency. An excessive training load causes incomplete adaptation and the sportsperson will have problems with recovery from the training stimulus. These problems with recovery can also be cumulative. This occurs when the loading is repeatedly too great or too closely spaced. The decline in performance caused by incomplete adaptation in one of the most obvious symptoms of overtraining. In this situation the coach must allow time for proper recovery and should evaluate and reduce the training loads used.



Over loading is of two types

1. Dominance of excitation process
   This state occurs when the training load is increased suddenly without adequate preparation.

2. Dominance of relaxation process
   This state results when the over does of training load is administered continuously over a longer period of time.

Causes of Over Loading

The main cause which lead to over loading can be discussed under the following four categories:

1. Faulty Training Method
   a) Neglect of recovery process
   b) Rapid increase in the training load thus adaptation does not take place.
   c) High volume of load with maximum or sub-maximum intensity.
   d) Forced technical training involving complicated movements without adequate rest.
   e) Excess of competition with high demands.
   f) One sided training.

2. Life Factors
   a) Insufficient night rest
   b) Irregular daily routine
   c) Luxurious daily routine
   d) Indulgence in alcohol and nicotine
   e) Bad living conditions
   f) Faulty leisure time activity
   g) Quarrel in the family or the community

3. Social Factors
   a) Excess of engagements
   b) Friction in the family
   c) Unsatisfied profession or studies
   d) Misunderstanding with colleagues

e) Over loading in professional work, studies etc.
f) An unfriendly family towards sports
g) Excess of entertainment programmes

4. Health Factors
   a) Fever
   b) Bad stomach
   c) Infectious disease
   d) Injuries

Symptoms of Over Load

The symptoms of over load are grouped as follows and they also appear in the same order:

1. Psychological symptoms
   a) Increased excitability
   b) Tendency toward hysteria
   c) Quarrelsome
   d) Less contact with the coach
   e) Increased sensitivity towards criticism
   f) Depression
   g) Indifferent
   h) Loss of confidence
   i) Loss of motivation

2. Performance Symptoms
   a) Increased error in technique
   b) Decreased concentration
   c) Decreased differentiation ability
   d) Decrease in strength, speed and endurance abilities
   e) Slow recovery
   f) Decreased competition readiness
   g) Increased tendency to surrender to competition

h) Uncontrolled behaviour in competition

3. Somatic-Functional Symptoms
   a) Loss of sleep
   b) Loss of appetite
   c) Loss of weight
   d) Disturbance in digestion
   e) Frequent giddiness
   f) Susceptibility to injuries

How to Tackle Over Load (Remedies)

Tackling of over load is not an easy task. The coach, sportsperson, sports doctor and sports psychologist should work together to tackle this serious problem. The following suggestions may be adopted.

1. The coach should recognize the state of over loading as early as possible by carefully observing the sportsperson during each training session. The coach should look for the psychological symptoms because they are the first to appear.

2. As soon as the coach is convinced that there are signs of over loading, the following four things should be done:
   a) The training load should be considerably reduced.
   b) Additional means i.e. good diet, physiotherapy, massage and general exercise should be adopted to accelerate recovery.
   c) Guidance of sports doctor, sports psychologist or any other expert be sought.
   d) Meeting with parents or other important persons be arranged.

3. Competition and trials be avoided.

4. The coach, with the help of friends, colleagues, parents, sports doctor and sports psychologist should make sincere effort to find out the real causes of over loading.

5. Over loading causes should be tackled by modifying training.

6. The training should be restarted with a revised plan.

Judgement of Training Load

Performance of a sportsperson improves as a result of application of training load. the frequency of training of a sportsperson depends upon the training age and performance level. A beginner trains 3 to 5 times per week whereas a high performer trains 8 to 12 or even more times in a week. In order to ensure that the load of training in a training unit guarantees development of performance, the load has to be properly controlled and regulated. Today, it is possible to correctly plan training load for a sportsperson by working out 'Target Training Zones' keeping in mind his age and resting heart rate. The judgement of training load can be done using the following means:

Objective Means

The objective means of judgement of training load involve assessment of physiological and bio-mechanical variables during and immediately after the training schedule. Some of the objective means of judgement of load, which can be effectively used by a coach, are as follows:

1. Body weight

2. Heart rate
3. Intensity of training load
4. Volume of training load
5. VO_2 max.
6. Blood lactate
7. Blood urea
8. Lon concentration (Acid-Base Balance)
9. Electrolyte concentration
10. PO_2 and PCO_2 in blood
11. Blood enzymes (SGOT and SGPT)
12. ATP and CP concentration
13. Glucose and fatty acids
14. Hormonal level e.g. glucogon, insulin and thyroxin.

The coach can do measurement in respect of some of the variables; however, in respect of others the coach has to depend upon the specialist. Due to the following reasons, the objective means for judgement of training load are to be cautiously used.

1. Most of the objective means indicate effect produced by the load on a specific organ or a system and not the whole body
2. Most of the objective means are associated with speed and endurance training.
3. As on date reliable objective means for judging the psychological aspects of load are not available.

Subjective Means

Since objective means of judgement of load need specialized equipment/apparatus and scientific procedure4s, the coach has to invariably rely on the subjective means. The accuracy with which subjective means can be used for judgement of training load depends upon:

a) Observational ability of the coach.
b) Knowledge of the coach with respect of various sports science.
c) Knowledge of the coach with respect to likely-effect of various training means and methods.
d) Experience of the coach.
e) Thorough knowledge about sportsperson's behaviour.
f) Knowledge about the personality of sportsperson.

The amount and type of training load depends upon the effects desired. Administration of optimum load causes fatigue and if fatigue can be correctly measured during and after training, the degree of load can be correctly assessed. Since fatigue cannot be directly assessed, the effect of training load has to be judged through its symptoms, which are as follows:

a) Colour of the skin
b) Sweating
c) Loss of concentration
d) Loss of co-ordination
e) Psychic factors e.g. readiness or preparedness, general feeling, general expression, confidence etc.

In order to correctly and reliably judge load the coach should rely on more than one symptom of fatigue. Some of the symptoms namely sweating and colour of the skin are not very reliable skin of the sportsperson and, therefore, are to be cautiously used. While judging the effect of load, the personality and behaviour of the sportsperson may be kept in mind. Response of the sportsperson to load depends upon these two factors.

Recovery

Both, training and competition loads enhance sports performance. In the process of long-term training, the quantum of load is gradually increased and this leads to improved performance. A beginner adapts to training load faster whereas with the increase in training age, higher loads are administered and this results in slower increase in performance.

Sportspersons cannot effectively undertake very high loads of training unless proper means are adopted to accelerate the process of recovery. Administering appropriate means can ensure quicker recovery and make a sportsperson capable of undertaking more frequent loads. Recovery from training and competition loads requires considerable amount of time. Recovery can be divided into following three phases:

Phase I

In this phase the onset of fatigue and recovery go on simultaneously i.e. when the training or competition is in progress? This process occurs because of resynthesis of ATP, CP, and glycogen and to some extent because of neutralization of lactic acid. Those activities, which continue for a long duration and those sports, which are played for a considerable period, the pace of recovery in this phase plays an important role. Recovery during this phase, to a large extent, depends upon functional capacity and efficiency of different systems and their organs.

Phase II

This phase commences with the completion of the training schedule (cessation of physical activity) and ends with the restoration of homeostasis of the body. This phase lasts from few minutes to 2 to 3 hours. The

following active recovery means can be adapted to make the recovery process faster.

1. Deep breathing exercises
2. Intake of drinks containing carbohydrates, vitamins, salts and minerals.

Phase III

The duration of this phase of recovery can last from many hours to several days. In this phase, the anabolic process facilitates the recovery. Substances such as enzymes and proteins, which get depleted in the process of undertaking the load, get resynthesised.

Factors Affecting Pace of Recovery

The pace of recovery is affected by the following factors:

1. Stimulus Intensity and Stimulus Volume (Factors of Load).

Recovery after loads dominated by intensity is quicker whereas it takes longer time when extensive loads (loads dominated by volume) are administered. Intensive loads lead to quicker onset of fatigue but after the cessation of load, recovery is also faster.

2. Types of Training Load

In order to improve different aspects of sports form, different types of loads are administered. Recovery is faster in the case of those loads where ATP and CP are used for energy production. Loads, which involve depletion of glycogen stores, recovery may take from almost 10 hours to two days. Recovery after strength loads may take 1-2 days or even longer.

3. Health and Fitness Status

In order to attain faster recovery, health and fitness of a sportsperson are important factors. Healthy and physically fit persons recover faster from fatigue caused by the training loads.

4. Rest and Sleep

Proper rest and sound sleep of 7 to 8 hours ensures complete recovery. In addition to physical and physiological recovery, sleep also helps in psychic recovery.

5. Good Diet

Good diet containing all important nutrients namely carbohydrates, fats, proteins, vitamins, minerals and water in required quantities is essential for faster recovery. Intake of nutrients such as carbohydrates, vitamins and minerals (sodium and potassium) in liquid from can facilitate quick recovery. Intake of food at fixed hours and proper eating habits also ensure faster recovery.

6. Daily Routine

Proper control has to be exercised on daily routine so as to ensure recovery from fatigue. If the biological clock is disturbed by making frequent changes in the daily routine, the recovery process is adversely affected.

7. Total Load of the Day

In addition to training and competition loads there are many other factors namely academic pursuits (in case sportsperson is studying) professional work (in case sportsperson is studying) professional work (in case sportsperson is employed), sharing household work, meeting weather and environmental stresses, injury etc. Which increase the total load of the day. In

case the total load goes beyond the loading capacity, the recovery process gets delayed.

Means of Recovery

The means, which can be effective in accelerating recovery, can be divided into following groups:

1. Training Methodology related means
2. Nutritional means
3. Physio-therapeutic means
4. Psychological means

1. Training methodology related means

Among all the four above groups, these means are the most important for ensuring quick recovery. In fact other means of recovery should support the training methodical means.

(i) Session of training

A training session should be carefully worked out for ensuring recovery. The following factors should be kept in mind.

(a) Warm up

A good session of warming up is essential for avoiding earlier onset of fatigue. Stretching exercises, which from an essential part of a warm up session are effective in preventing stiffness and soreness in muscles.

(b) Exercise sequence

The exercises to be performed should be arranged in a sequence so that different muscle groups, organs and systems are stressed in rotation. This sequence can help in delaying the onset of fatigue and quarantines quick recovery.

(c) Sequence of performance tasks

In addition to exercises, the performance tasks should also be arranged in a sequence. In a training session the speed, co-ordinative abilities and technique should be developed first followed by strength. The endurance training should be at the end of the session.

(d) Phases of rest between repetitions of load

Between repetitions of load, measured rest periods should be provided in order to make the load effective and also make the sportsperson capable of completing the training schedule. Active rest pauses (doing low intensity exercises during rest pauses) ensure faster recovery.

(e) Limbering down

Every training session shall end with limbering down (cool down) which should be done for 10 to 20 minutes in order to recover and bring the body back to normal level of functioning. During limbering down, low intensity continuous exercise should be performed so as to quickly remove the metabolic products from muscles and blood.

2. Cyclic Process of Training

The year is divided into cycles of training of varying durations. Macro cycle is the longest cycle and its duration is from 3 to 12 months. It is divided into preparatory, competition and transition periods. Transition period of 4 to 6 weeks ensures recovery because during this phase training loads are of low intensity and volume. This phase provides recovery and relaxation of the sportsperson after strenuous training during preparatory and competition periods.

The duration of meso cycle is 3 to 6 weeks. The last week of the meso cycle is devoted for recovery. During the last week the training load is low and general exercises dominate. Micro cycle is the shortest of the three cycles and its duration is normally one week. On the last day of the week complete rest is provided to ensure recovery.

During these cycles the training load fluctuates and is applied with certain rhythm. During these cycles the training tasks should be tackled in way that speed and technique come in the beginning and endurance comes at the end.

3. Nutritional Means

During and after training and competition nutritional means taken in proper form and required quantity can help in ensuring faster recovery. The sportsperson should take balanced diet, according to the requirements of the body and the sport for which one is training. After every training session light liquid diet containing carbohydrates, vitamins and minerals (sodium and potassium) should be consumed. Intake of drinks with salt added is also recommended if during training session the sportsperson had profuse sweating. It is also advised that meals should be consumed at fixed hours.

4. Physio-therapeutic Means

These means are being effectively used for accelerating recovery. Different massage manipulations, sauna, ultra sound therapy, hydrotherapy, electrotherapy etc. are helpful in quick recovery. For these means help of a specialist should be taken in order to avoid problems. These means should be used in addition to means related to training methodology. Avoid using them as substitute means for training methodical means.

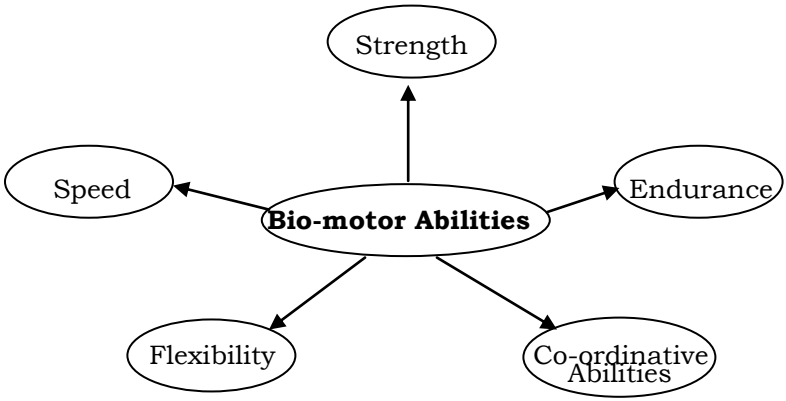
5. Psychological Means

Over the years, the psychological means have become important in helping sportsperson in attaining faster recovery. Physiological evidences show that the recovery process is controlled by the nervous system of the body and the psychological means help in the voluntary control of this system for attaining quick recovery. Psychological means, like other means can be used during and after training or competition and they can even be used between two training sessions for relaxation and ensuring sound sleep. Some of the important means which are being commonly used by the sportspersons are: (i) different forms of yoga, (ii) autogenous training, (iii) auto-suggestion and (vi) progressive relaxation technique. In order to learn and use these means to the best advantage, the sportsperson may take help of a specialist. After having learnt them correctly, he may independently use them.

Chapter 3

Bio-motor Abilities

Complete physical preparation is an important pre-requisite for attaining high performance standard in games and sports. In view of this coaches provide sufficient time in their training schedules for the enhancement of important bio-motor abilities (motor qualities) namely strength, speed, endurance, flexibility and co-ordinative abilities.



Through different training means, the above bio-motor abilities can be trained separately as well as in combination with each other. The requirement of these abilities differs from sport to sport and in order to develop these abilities, the sportspersons have regularly participate in general, specific and competitive exercise schedules, which are specific to sport. For example, when a sportsperson works against a resistance, may be resistance of own body, partner, medicine ball, barbell etc. strength is developed. Running at high speed with quick frequency of movement would develop speed. If distance or duration is maximum, the exercise becomes endurance based. Exercises with complex movements involving eye-hands and eye-foot co-

ordination contribute to development of co-ordinative abilities. Static and dynamic exercises lead to development of flexibility. Different sports place different demands on the above co-ordinative abilities and therefore the coaches should prepare the training programmes for enhancement of bio-motor abilities keeping the specific demands of the game/sport in mind.

Each sportsperson has a unique profile in respect of different bio-motor abilities. In as much as there is a closed relationship between skill performance and performance in respect of various motor abilities, it is important that a coach must understand how to train them as well as how to determine them with the help of different evaluative procedures. Highly talented sportspersons only may posses the various biomotor abilities to optimal level so as to put up a good performance. In fact at the time of talent selection a lot of weightage shall be given to the various biomotor abilities because at that young age children do not have good level of skill. The coaches have a responsibility to identify sports/events for which sportspersons are best suited and to develop in them those motor abilities, which are essential for optimum performance.

Sports will require these characteristics in successful performers but the importance of each may vary. For example, the successful 100m runner is a powerful athlete, the gymnast requires flexibility, and the 1500m swimmer relies largely on endurance. In the team sports, depending on the position played, all these characteristics may all be important. In all sports, these physiological capacities will need to be supplemented by a high level of skill and the correct psychological approach to competition.

Definitions of Important Motor Abilities

1. Cardio-respiratory Endurance
   This is the quality that enables one to continue engaging in reasonably vigorous physical activities for extended periods of time where the required cardio-respiratory adjustments to the activity are built up.

2. Muscular Endurance
   This motor component enables a person to sustain localized muscle group activities for extended periods of time.

3. Strength
   Strength is the ability of a muscle to get over resistance.

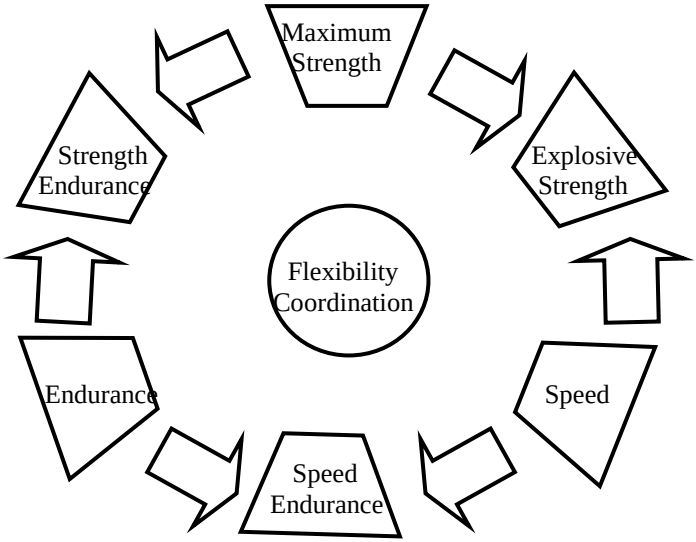
4. Speed
   Speed is the ability to make rapid movements of the same type in the shortest possible time.

5. Power
   It is the quality of a muscle to contract forcefully in the quickest possible time.

6. Agility
   It is the ability of the human body to change direction quickly and effectively.

7. Flexibility
   It is the ability of a muscle to perform movements with greater range of motion.

8 Co-ordination
   It is the ability to perform movements of various degrees of difficulty very quickly and with efficiency and accuracy.



Inter-relationship of the biomotor abilities

Chapter 3.1

Strength

Strength is perhaps the most important motor ability in sports because all movements in sports are caused by muscle contraction. Therefore, strength is a part and parcel of all-motor abilities, technical skills and tactical actions (Uppal, 2000). The development of strength has almost certainly been the greatest factor to enhance performance in sports. But it is not a new concern. Theories of the best way to build up strength date back at least to ancient Greek times, when Milo reputedly carried a bull calf every day from the day it was born until it was fully grown. As the bull grew and became heavier, Milo's strength levels improved to compensate, in a form of early progressive resistance training (Paish, 1998).

Strength alone will not assure success in any sport. It is usable strength that is the key, the strength which can be applied to the body to make it more faster, change speed, change the direction of body movement, put a greater speed into a cricket bat or racket head, or make the pull on an oar faster and longer. Hence, while strength is a dominant factor one must also call upon skill, mobility and speed. A pupil will not be able to hold the tennis racket as instructed if he does not have sufficient strength. How can a pupil learn to pole vault if he cannot hold his own weight? Moreover, lack of sufficient strength results in rapid muscular fatigue, which limits the amount of practice time available for learning skills.

Proper muscular development helps to prevent muscular imbalances that may result in compensating movements when a child is attempting to learn new

skills. We have all seen injured people favouring their good (strong) sides. A similar compensating mechanism may result if a youngster does not have sufficient strength to hold the tennis racket as instructed. In order to hold the racket he will compensate by calling into play more muscles than would properly be necessary. These compensating mechanisms may result in imbalance, which if not corrected, become progressively more difficult to rectify.

Strength is the ability to overcome resistance or to act against resistance (Singh, 1991). Strength has been considered as the most important conditional ability. It has been the most significant factor to enhance sports techniques and performance. Development of strength also contributes to indirect development of other conditional abilities namely speed and endurance.

Strength is the most important conditional ability. Development of strength also contributes to indirect improvement of other two conditional abilities i. e. speed and endurance. Strength is produced as a result of contraction of muscle and all movements in sports are caused due to contraction of muscles, therefore strength is important for achieving good performance in sports.

Some people have the idea that strength is something needed only by males. The general misconception is that if females work on strength training schedules, they will have bulging muscles. This viewpoint is incorrect. In fact the hormones in the body of the females prevent them from developing bulging muscles. Females who do regular strength training for general fitness development are more likely to develop better contours and look more attractive and beautiful.

Definition of Strength

Strength is the ability of a muscle to get over resistance.

While playing different games and sports, the sportspersons overcome the following four types of resistance:

(a) Resistance of equipment
(b) Resistance of own body.
(c) Resistance of opponent.
(d) Frictional resistance.

Factors Determining Strength

Strength depends upon the following factors:

a) Physiological cross-section of the muscle
As a result of regular strength training, the diameter of a muscle increases (hypertrophy) and it becomes capable of producing more strength.

b) Morphology of the muscle
A person with dominance of fast twitch (phasic) muscle fibres can produce more force because fast twitch muscle fibres contract faster.

c) Co-ordination of muscles that participate in the movement
In every movement, two groups of muscles are involved i.e. agonist and antagonist. When the agonist contacts, the antagonist should completely relax. This co-ordination between the two can result in greater amount of strength.

d) Phosphogen store in the body
Muscle needs energy for contraction, which comes from the breakdown of phosphogens (ATP and CP). Greater the phosphogen store in the

body, higher will be the production of energy for contraction of muscles.

e) Body weight

A person with higher body weight is generally considered stronger than the lighter person. The weight categories in combative sports namely wrestling, boxing, judo etc. are based on this philosophy.

f) Psychic factors

Psychological factors, namely motivation, emotion, anger, aggression etc. have direct bearing on strength performance.

Types of Strength

(a) Maximum Strength –It is the ability of muscle to get over resistance of maximum intensity of stimulus in a single muscular contraction. The best examples are weight lifting and throwing events (shot, discus and hammer throws in track and field).

(b) Explosive Strength –It is the ability of muscle to get over resistance of sub-maximum intensity of stimulus as possible. The best examples are sprints, jumps, smashing in volleyball, hitting in hockey etc.

(c) Strength Endurance –It is the ability of muscle to get over resistance of medium intensity of stimulus for as long time as possible. The best examples are long distance races in track and field, swimming, distance cycling, wrestling, boxing etc.

Characteristics of training different forms of strength				
Type of Strength	**Intensity**	**Density**	**Frequency**	**Duration**
Maximum Strength	90-100%	6 to 10 min. (full recovery	1 to 4	More
Explosive Strength	70-80%	6 to 10 min. (full recovery	6 to 10	Short
Strength Endurance	50%	2 to 4 min	15 to 30	Short

Types of Muscle Contraction

For the development of strength, the following four types of muscle contractions are utilized:

1. Isotonic, Dynamic or Concentric Contraction

In this contraction the muscle shortens with varying tension while lifting a constant load. The literal meaning of the word isotonic is constant tension i.e., *iso* means constant and *tonic* means tension. Keeping in mind this meaning of the term, this contraction is expected to produce same amount of tension while contracting as it overcomes same resistance throughout the entire range of movement. But this is not true because the tension produced in the muscle as it shortens is affected by the following three factors:

a) Initial length of the muscle fibres.
b) Angle of pull of the muscle
c) Speed of contraction

Advantages of Isotonic Method

a) Since isotonic method involves movement, it enhances co-ordination.
b) This method is good for improving technique.
c) It is effective for developing speed of movement and endurance.
d) In as much as this method involves concentric movements, the resultant force developed is much greater as compared to other methods of strength development.
e) Strength developed through this method can be maintained for longer period.

Disadvantages of Isotonic Method

a) The contraction of muscle is not systematic and objective.
b) The time for which contraction is maintained is short.
c) This method requires specialized equipment (barbells, medicine balls etc.)
d) Distribution of energy is much greater because movement is repeated several times.
e) Muscle injuries are more frequent in this method.

2. Isotonic, Dynamic or Eccentric Contraction

In this contraction, the muscle lengthens while contracting (developing tension) i.e. both the origin and insertion on the muscle move away while the muscle is contracting. This contraction can be best explained with the example of elbow flexion against resistance. Flex your elbow and have someone trying to extend your forearm by pulling down on your wrist. At the same time, resist the pull by attempting to flex your elbow. As your forearm is extended, the elbow flexor muscle will lengthen while contracting.

In our normal usage, eccentric contractions are based in countering the effect of gravity i.e. while

waling down the hill or stairs. In sports, it is used in activities like wrestling where one competitor resists the effort of the other to forcefully move the arm or the leg but ultimately lose out in the struggle.

3. Isometric or Static Contraction

In this contraction tension is developed in the muscle working against resistance but there is no change in the length of the muscle. The literal meaning of the word isometric is constant length i.e., *iso* means constant and *metric* means length. The reason why the muscle does not shorten in this contraction is because the external resistance against which the muscle is pulling is much higher than the maximum tension (internal force) the muscle can produce.

Advantages of Isometric Method

a) Muscle can be co9ntracted more systematically and objectively.
b) The duration of contraction is longer (6 to 10 seconds).
c) Because of longer contraction, too many repetitions are avoided.
d) Need for energy requirement is less and due to this sportsperson does not get tired.
e) There is no requirement of specialized equipment.

Disadvantages of isometric Method

a) Since this method does not involve movement, it is bad for the development of coordination and skill.
b) It does not contribute to development of speed of movement.
c) It is not effective for development of endurance.
d) Strength developed using this method is not maintained for long time.

The conclusions of research studies undertaken to compare the isotonic and isometric training programmes are summarized as follows:

a) Since isotonic exercises are self-testing in nature, motivation technique can be used more effectively with this method. However, to use this method effectively, sufficiently space and special equipment are needed. On the other hand isometric can be performed any where (even in homes and offices) because they do not require any6 specialized equipment and requirement of space is limited.

b) Both the methods (isotonic and isometric) enhance strength. The scholars have not shown the superiority of one over the other. (isotonic and isometric) enhance strength. The researchers have not shown the superiority of one over the other. However, there are few references reporting greater gains for trainees using isotonic exercises.

c) Isotonic method develops muscular endurance more effectively as compared to isometric method.

d) Recovery from muscular fatigue is quicker after isotonic exercise than after isometric exercise.

e) Isotonic method brings about uniform development of strength over the entire range of motion whereas in respect of isometric method, more strength develops at one point in the range of joint motion i.e., the point at which position is held and tension is created in the muscle.

4. Isokinetic Contraction

This procedure involves development of maximum tension in the muscle, which shortens at constant speed at all angles over the full range of motion.

The literal meaning of the term isokinetic is constant speed i.e./so means constant and kinetic means speed. Such contractions are more commonly involved in sports performance; a good example is arm stroke in butterfly style swimming.

Although isokinetic and isotonic contractions are both concentric i.e. involve shortening, the two are not same. In isokinetic method, maximum tension is developed in the muscle throughout the entire range of motion but not in isotonic method. Besides in isotonic contraction the movement is not controlled and takes place relatively slow.

For performing isokinetic exercises, special isokinetic machines are required. These machines have a speed governor so that the speed of movement is constant, no matter how much tension is created in the muscle. Therefore, in this method when quick movements are done, the muscle generates maximum tension throughout the entire range of motion, but the speed of movement will be constant. This special feature of the isokinetic machine is called “accommodating resistance”. Isokinetic method is considered to be the best for improving muscular strength and endurance for sports.

COMPARATIVE EFFECTS OF FOUR TYPES OF MUSCULAR CONTRACTIONS

Comparative Rating Criterion	Isotonic		Isometric	Isokinetic
	Concentric	Eccentric		
Improvement of co-ordination & skill	Excellent	Poor	Good	Good
Increase in strength over range of motion	Good	Good	Poor	Excellent
Rate of strength improvement	Good	Good	Poor	Excellent
Rate of endurance improvement	Good	Good	Poor	Excellent
Requirement of time per training session	Poor	Poor	Excellent	Good
Expense	Good	Good	Excellent	Poor
Ease of performance	Poor	Poor	Excellent	Good
Suitability for progress assessment	Excellent	Excellent	Good	Poor
Adaptability to sports movement pattern	Good	Good	Poor	Excellent
Prevention against injury	Poor	Poor	Good	Excellent
Protection against muscle soreness	Poor	Poor	Good	Excellent
Saving of energy	Poor	Poor	Excellent	Good

Assessment of One-Repetition Maximum

Muscle strength refers to a muscle's maximum force generating capacity. The maximum weight (resistance) lifted with proper form for one repetition (1-RM) for a particular muscle action measures dynamic muscular strength. A trial-and-error approach determines the 1-RM strength value. After each successful single lift, the weight is increased by one to five Kg. until the maximum weight is achieved. The individual rests 2 to 3 minutes between attempts. It is possible to estimate 1-RM from sub-maximal effort. The

following equations can be used to estimate 1-RM from 7- to 10-RM for untrained and trained persons.

Untrained person

1-RM, kg=1.554 (7-to 10-RM, kg) – 5.181

Trained person

1-RM, kg=1.172 (7-to 10-RM, kg) + 7.704

Example: Estimate 1-RM for an untrained person whose 10-RM equals 50kg.

1-RM =1.554 x 50 –5.181 = 72.5kg

Sportspersons adopt numerous training means for improving strength. The popular means adopted are:

i) Training with free weights and weight stations using fixed and variable resistance
ii) Training with medicine balls
iii) Pushing and pulling against immovable objects
iv) Machines equipped with mechanical devices
v) Partner exercises
vi) Own body resistance exercises with and without apparatus
vii) Exercises with rubber cord
viii) Exercises with Swiss ball
ix) Pulley and cable exercises
x) Exercises using frictional resistance

Methods of Strength Development

Weight training and many other forms of resistance exercises (using gadgets other than barbells and weight plates) are effective means of developing different forms of strength. The intensity, density, duration and repetitions have to be so planned that exercises contribute to development of different types of

strength. For resistance exercises, movements can be performed against ones own weight, weight of the partner, and even weight jackets, wrist and ankle collars can be used to increase resistance. Medicine ball exercises, rubber cables exercises, harness running and different forms of partner exercises can be performed to improve strength.

Weight training enables an individual to use the progressive resistance technique (PRT) most effectively. After having done strength training exercises for some time, the individual gets adapted to the load and the moment he gets adapted the resistance which was originally hard to overcome, becomes easier as the training period progresses. To ensure further increase in strength, the resistance is progressively increased.

Utilizing the four forms of muscle contractions namely isotonic, isometric, eccentric and isokinetic, different methods of strength training are planned. Variations are made in intensity, repetitions, number of sets and recovery between sets and series so that different forms of strength can be trained. For developing maximum strength, intensity is high and repetitions are less, for explosive strength, intensity is sub-maximum and repetitions are performed as fast as possible and for training strength endurance, intensity is medium and several repetitions are performed. For maximum and explosive strength, recovery is complete between sets whereas for developing strength endurance the recovery phase between two sets is short (refer characteristics of training different forms of strength). In order to avoid injuries, good warming up prior to strength training is of great significance. The coach should explain all the important precautions to be taken to prevent injuries. Spine of the body is the most injury prone area. In all strength training

exercises, the spine should be kept erect at all times. In the beginning stages, spotters may be used while working with barbells. The popular methods of strength training are:

i) Simple method of system
ii) Combination method or system
iii) Super set method or system
iv) Pyramid method or system
v) Plyometrics or reactive method
vi) Circuit training

1. Simple Method

   This method is recommended for the beginners. A simple schedule of 6 to 8 exercises is developed so as to cover all major muscle groups of the body. 3x8 repetitions of each exercise are performed. The exercises should be so arranged that each main muscle group is exercised in turn e.g. leg exercise can be followed by one designed to promote strength in either the arms or the trunk. In this method exercises are not performed in a circuit method. Required number of repetitions and sets of each exercise are completed before proceeding to the next exercise. Variations in intensity, repetitions, sets and recovery can be done to develop different forms of strength.

2. Combination Method or System

   This method is most suited for developing strength endurance. This system is not at all recommended for maximum strength development. The procedure is very much similar to simple method. Combined method differs from simple method in terms of recovery to be provided between various sets. Progressive Resistance Technique (PRT) can be very effectively

implemented in this method. Using the same 6 to 8 strength training exercises, as for the simple system, exercise 1 and 2 are combined, as are 3 and 4, 5 and 6 and ultimately 7 and 8. The sportsperson performs one set of eight repetitions of exercise 1 and immediately switches over to exercise 2. After performing eight repetitions of exercise 2, one returns back to exercise 1 until three sets of 8 repetitions of both exercises are completed. The recovery period, which the first muscle group gets, is the time for which exercise 2 is performed.

3. Super Set Method or System

This method is most suited for development of maximum strength. However, it can also be used for training other forms of strength. Since this approach please stress on high intensity workouts, it is not recommended for beginners. This system is similar to combination method in all respects except categorization of exercises. Two arm or leg exercises are combined in such a way so that the flexor and extensor muscles are trained one after the other. Between a set for developing flexor and a set for developing extensor muscles, no recovery is provided.

i) Sit ups
ii) Back Hyperextension
iii) Half Squat
iv) Leg Curl from supine position
v) Arm Curls
vi) French Press.

Three sets, each of 6 to 8 repetitions, are performed.

4. Pyramid Method or System

This method is best for developing maximum strength. In this system any strength training exercise is chosen and in each set 3 to 5 repetitions are performed with maximum load. The procedure involves near maximal concentric contractions. Between two sets complete recovery should be ensured. A good warm up sessions is an important pre-requisite for this method. Example:

1 set of three repetitions with a load of 90% $\frac{90\% \times 3}{1}$

1 set of two repetitions with a load of 95% $\frac{95\% \times 2}{1}$

1 set of one repetition with a load of 100% $\frac{100\% \times 1}{1}$

1 set of two repetitions with a load of 95% $\frac{95\% \times 2}{1}$

1 set of three repetitions with a load of 90% $\frac{90\% \times 3}{1}$

5. Plyometrics or Reactive Jumps

Since ages sportspersons have been trying to design training methods which would enable them to run faster, jump higher, and throw an object farther. To achieve such goals, power is essential. Strength gains can be transformed into power only by applying specific power training. Perhaps one of the most successful methods is training that employs plyometric exercises. Plyometrics is known as the stretching shortening cycle, or myotatic stretch reflex, in which the muscle is loaded in an eccentric (lengthening) contraction, followed immediately by a concentric (shortening) contraction. Research has demonstrated that a muscle stretched

before a contraction will contract more forcefully and rapidly (Bosco & Komi, 1980; Schmidtbleicher, 1984). For example, by lowering the center of gravity to perform a takeoff, the athlete stretches the muscle, resulting in more forceful contraction.

The term plyometrics has been derived from the Greek word pleythyein, meaning, “to increase” and the shorter Greek words plio “more” and plyo “to move”. Metrics means “length”. The word plyometric originally appeared in Russian sports literature in 1966 in work completed by V. M. Zaciorskij. Plyometric action relies on the stretch reflex found in the belly of the individual muscle. The main purpose of the stretch reflex is to monitor the degree of muscle stretch and prevent overstretching. When an athlete jumps, a great amount of force is required to propel the body upward. The body must be able to flex and extend quickly to leave the ground. A plyometric exercise relies on this quick body action to attain the power required for the movement.

Plyometric movement is based on the reflex contraction of the muscle fibers resulting from the rapid loading of these same fibers. When excessive stretching and tearing become a possibility, the stretch receptors send proprioceptive nerve impulses to the spinal cord. Then the impulses rebound back at the stretch receptors. Through this rebounding action, a braking effect prevents the muscle fiber from stretching farther, releasing a powerful muscle contraction. The following exercises are done for developing explosive strength of lower and upper extremities:

1. Hopping
   The primary emphasis in hopping is to achieve height or distance with a maximum rate of cyclic leg movement. It is described as a takeoff and

landing movement from one leg onto the same leg. The height of the hop is gradually increased. In each set 15 to 25 repetitions are performed. Between sets full recovery is provided. In all 3 sets are recommended.

2. Bounding

The emphasis in bounding is to gain maximum horizontal distance, with height being a factor in the success of that distance. It is described as taking off from one leg and landing on the other. This exercise involves alternate hopping stepping. 3 to 5 sets each of about 20 repetitions are performed. Between sets full recovery is provided. Standing hops and jumps, with different combinations of hops and jumps can be performed. Between sets full recovery is provided.

3. Depth Jumps.

This method involves jumping down from a height of 40 to 120 centimeters and then jump forward for distance or jump up for height. 3 to 5 sets, each of 10 repetitions, are done. Full recovery between two sets is provided. Initially all movements should be done with both feet and gradually with increase in strength, jumps with one leg can be performed. For jumping, boxes and benches of varying heights can be used. In order to avoid injuries, the landing should be done on the toes. Heels should not touch the ground. While landing after executing a jump from a height, one must land with knee angle of about 120^0 to 140^0 and should give in up to 90^0-100^0 i.e., the optimum range of bending is 30^0-50^0. In as much as this method is very strenuous, it is recommended only for highly conditioned sportspersons. Some coaches are of the opinion that this procedure leads to knee and ankle

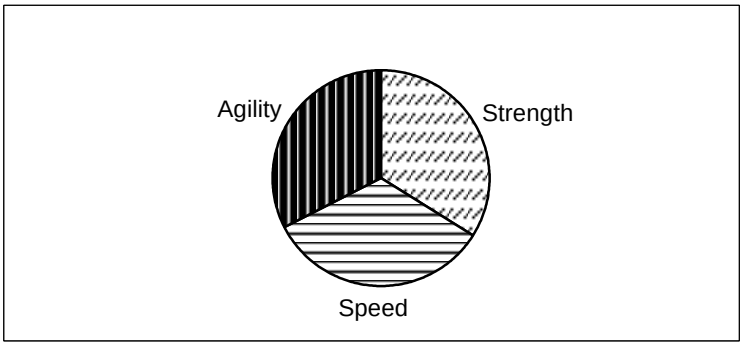
injuries and also produces soreness and stiffness in the leg muscles. However, if planned properly after through warming up possibilities of injuries can be avoided.

4. Medicine ball exercises

A variety of medicine ball exercises can be performed especially for improving the explosive strength of the upper extremity. Some of the popular exercises are:

i) Medicine ball over and under
ii) Medicine ball half and full twist
iii) Medicine ball scoop toss and throw
iv) Medicine ball chest pass
v) Supine two-arm overhead throw
vi) Kneeling two-arm overhead throw
vii) Standing two-arm overhead throw
viii) Sit-up throw
ix) Stepping two-arm overhead throw
x) Chest push from kneeling position

In plyometric training loads should be included for the development three components namely strength, speed and agility. For efficient performance, the above three components should be developed in equal amount.



The following equipments are used for plyometric exercises:

1. Wooden boxes
2. Cones made of rubber or plastic
3. Dumbbells
4. Hurdles
5. Landing pits
6. Medicine balls
7. Stair steps
8. Weight jackets
9. Wrist and ankle collars
10. Rubber tubes and bands

There isn't any special attire necessary for explosive power training. Any athletic workout clothing that is comfortable; wears well; and does not bind, hinder, or confine the joint movements is acceptable. Shoes have been given much importance regarding explosive training. The comfort, stability, and design of the shoe do play a part, especially with continued and constant training. However, the main issue is proper foot, ankle, and lower leg-landing positions. These mechanics should be the most important

emphasis. The proper blend of exercise surface and footwear that fosters attention to mechanics is what we should strive for.

Because plyometric exercises emphasize posture, balance, flexibility, stability, and mobility, you should precede all drills with an adequate warm-up and conclude with a proper cool down. Preparatory warm-up routines include jogging, calisthenics, and dynamic stretching methods, which are important to ensure the musculoskeletal systems are activated and prepared. Static stretching can follow to ensure well-loosened muscles connecting all the joints and tendons you will use in subsequent activity. After the general warm-up, doing specific warm-up routines will ensure optimal preparation for quality work. Technical form running (forward, lateral, and backward), lifting (using a light bar or stick in pulling, squatting and pushing movements), and progressive takeoff and throwing motions should also form a part of special warming up.

This method is effective for development of explosive strength. This system involves stretch-shortening (the muscle first stretches against resistance and then contracted maximally) cycle of the muscle. The following exercises are done:

(a) Initially all movements are down with both legs together and hopping is done on the spot. The height of the hop is gradually increased. In each set 15 to 25 repetitions are performed. Between sets full recovery is provided. In all 3 sets are recommended. For advanced sportspersons, single leg hopping is recommended in 3 sets of 10 repetitions with full recovery rest intervals between sets.

(b) This exercise involves alternate hopping and stepping. 3 to 5 sets, each of about 20 repetitions

are performed. Between sets full recovery is provided. Standing hops and jumps, with different combinations of hops and jumps can be performed. 5 sets of 6 to 8 repetitions are performed. Between sets full recovery is provide.

(c) This method involves jumping down from a height of 40 to 120 centimeters and then jump forward for distance or jump up for height. 3 to 5 sets, each of 10 repetitions are done. Full recovery between two sets is provided. Initially all movements should be done with both feet and gradually with increase in strength, jumps with one leg can be performed. For jumping, boxes and benches of varying height can be used. In order to avoid injuries, the landing should be done on the toes. Heels should not touch the ground. While landing after executing a jump from a height, one must land with knee angle of about 120^0 to 140^0 and should give in upto 90^0-100^0 i.e., the optimum range of bending is 30^0-50^0. In as much as this method is very strenuous, it is recommended only for highly conditioned sportspersons. Some coaches are of the opinion that this procedure leads to knee and ankle injuries and also produces soreness and stiffness in the leg muscles. However, if planned properly after through warming up possibilities of injuries can be avoided.

6. Circuit Training.

Circuit training is an effective method of developing strength endurance. A circuit of 6 to 10 exercises is arranged in such a way that different muscle groups are exercised at different stations. The performer moves from one station to another and undertakes load and recovery in the following two ways i.e.,

(a) 30 seconds exercise and 30 seconds rest between two stations.
(b) 20 seconds exercise and 40 seconds rest between two stations.

Generally 3 to 5 sets are performed and the actual number depends upon the training state of the sportsperson. Between sets full recovery should be provided. The intensity of exercise at each station is about 40 to 50% of maximum.

CIRCUIT TRAINING

It is training method by which exercises of various kinds are performed in sequence with or without apparatus after having given a dosage (No. of repetitions, intensity of stimulus, duration of pauses etc.), planned before hand and interspersed by intervals. This method of training aims at developing strength and endurance in an individual. While setting up a circuit the following points are kept in mind.

1. Exercises must be simple to perform at a predetermined work rate.
2. Exercise load (repetitions, weight, etc.) must be on an individual basis.
3. The selected exercises must be strenuous, loading the individual, within his exercise tolerance level.
4. Exercise stations should be so arranged that the same muscle groups are not being used at successive stations.
5. Usually select 6 to 10 exercise stations.
6. Determine maximum loading for each individual and reduce it to one half.
7. Practice the circuit doing the required number of repetitions (go through circuit once).

8. Have each participant go through his circuit once as fast as possible.
9. At the next session, repeat the circuit three times with rest period and record the time.
10. Determine a target time by taking two third of the average recorded time.
11. Repeat circuit until target times is achieved.
12. Change dosage and establish new target time.

Important points to be kept in mind when planning a circuit:

- Use simple exercises that work large muscle groups.
- Use a correct order (sequence) of the exercises (no doubling up).
- Ensure different muscle groups are exercised in turn.
- Encourage simple exercises (less injury risk).
- Set time or work intervals appropriate for developmental age and fitness.
- Be sure that time of rest intervals includes rest time between each circuit.
- Give active rest stations particularly for the younger age groups.
- Keep the circuit simple until players gain more experience.
- Give clear instructions regarding the organization of the players.
- Consider the fitness level and game style requirements of the players.
- Use music if possible for motivation.
- Clearly state the direction of the circuit.
- Ensure players breathe out as they perform the power phase, and breath in as they relax back to the start position.
- During the cool-down include flexibility exercises.

The following exercises can be included in a circuit.

i) Agility runs (cardiovascular endurance, agility)
ii) Squat thrust (agility and whole body activity)
iii) Bent leg sit-ups (abdominal strength & endurance)
iv) Step-ups (leg strength and cardiovascular endurance)
v) Standing long jump (leg power)
vi) Push-ups (arm and shoulder strength and endurance)
vii) Jump and reach and Baithaks (leg power)
viii) Chins (arm and shoulder strength and endurance)
ix) Rope climbing (strength and endurance)
x) Stair running (strength & endurance)
xi) Weight training (strength)

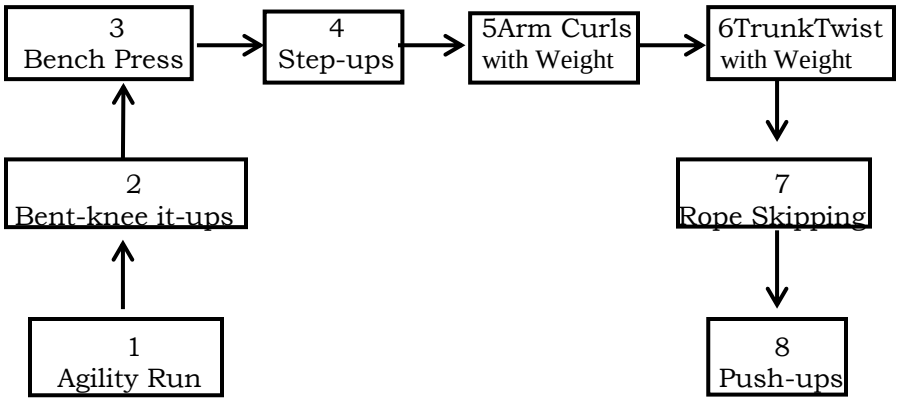


Fig. Circuit of Eight Stations

Management of Strength Training Programme

Effective management of strength training deals with actual performance of strength training in a training unit (training schedule). For proper management, two important points are to be kept in mind. They are:

i) Procedure of arrangement of strength training exercise.
ii) Procedure of administering strength training load during a training session.

Procedure of Arrangement of Strength Training Exercise

Three procedures are adopted:

i) Simple Training System (Station Training)

This system develops all forms of strength. According to the training state of the sportsperson and the form of strength to be developed, require number of repetitions and sets of an exercise are done. the performer completes one exercise and then proceeds to the next. The recovery period between two exercises will depend upon the type of strength to be trained.

ii) Set Training System

All forms of strength can be developed using this procedure. However, it is more suitable for improving strength endurance. In this variation all sets of an exercise (generally) 2 to 3 exercises) are completed before proceeding to the next set. The recovery period between the sets will depend upon the form of strength to be developed.

iii) Circuit Training System

This system is most effective for improving strength endurance. A circuit of 6 to 10 exercises is arranged and exercises are done one after the other. Number of rounds to be performed will depends upon the training state of the sportsperson. Generally two to

four rounds are performed. Administration of load and recovery is done in two ways i.e.

a) Exercise for 30 seconds and rest between two stations is 30 seconds.
b) Exercise for 20 seconds and rest between two stations is 40 seconds.

Procedure for Administering Training Load

This procedure involves amount of resistance and the number of repetition of an exercise. The important loading procedures are as follows:

i) Fixed Resistance and Fixed Repetitions

Each set of strength training exercises is performed with constant resistance and a fixed number of repetitions. Exercises could be done with high resistance or with low resistance. While performing exercise with high resistance, the repetitions are less and when exercise is done with low resistance, the number of repetitions is high.

ii) Increasing Resistance and Fixed Repetitions

In each set of strength training exercises, the resistance is gradually increased from one set to another but repetitions are kept fixed.

iii) Varying Resistance and Varying Repetitions

In this system, the resistance to be overcome and the number of two ways namely-

a) Progressive system in which resistance increases from one set to another and the number of repetitions decrease e.g. 4x70%, 3x80%, 2x90%, 1x100%.

b) Progressive-regressive system which involves progressive increase of resistance and decreasing repetitions in the first half and gradually decreasing

resistance and increasing repetitions in the second half e.g., 5x70%, 3x80%, 1x100%, 3x85%, 5x70%.

iv) Reducing Resistance and Fixed Repetitions

This procedure involves performance of large number of repetitions in several series. In each series, the repetitions are kept fixed but from one series to another, resistance is progressively reduced.

v) Contract Method

In this system of strength development sets are performed in such a way that the high and low resistance alternate. The resistance is increased in steps over period of weeks. e.g., 60%, 20%, 80%, 35%, 80%, 40%.

Another possibility of using this method is to perform 2 to 3 sets with high resistance followed by 2 to 3 sets with 5% to 10% lower resistance.

Strength Training for Children

Although resistance training for children has gained popularity, its benefits and possible risks remain relatively unknown. Because of incomplete skeletal development in young children and adolescents, obvious concern arises about the potential for bone and joint injury with heavy muscular overload. Furthermore, one might question whether resistance training improves strength at a relatively young age because the hormonal profile continues to develop (particularly for the tissue-building testosterone). Limited evidence indicates that closely supervised resistance-training programme, using concentric-only muscle actions, with high repetitions and low resistance, significantly improve children's muscular strength with no adverse

effect on bone or muscle (McArdle, Katch and Katch, 1991).

The following suggestions are given for developing strength among children:

1. Exercises against one's own body weight, partner exercises, jumping exercises, exercises with medicine balls and other similar movements should form the main part of strength training for children.
2. The exercises should be done with low intensity.
3. Along with strength, flexibility exercises should also be performed.
4. To avoid injuries, strength training should be planned on long-term basis.
5. Greater stress should be laid on general exercises.
6. Short sets are more useful than higher ones.
7. In the initial stages, isometric exercise should be avoided.
8. Variations of exercises should be performed.

Increase in intensity should be done as per the table given below.

Age	Training Age	Intensity
14	1	20-50%
15	2	30-60%
16	3	40-70%
17	4	50-80%
18	5	60-90%
19	6	70-100%

Strength Training for Women

For many years strength exercises using different forms of resistance were not recommended for women. It was thought that it would cause "masculinisation". Hypertrophy of muscles does take place when women do strength training, however, the extent of hypertrophy is less when compared with men. This is mainly due to low circulating levels of androgen, progesterone, estrogen and testosterone. Tittel working with 272 women and 253 men concluded that training increases strength in women but women have about 35% less strength performance as compared to men. He also pointed out the strength trainability in women is less. However, the fact is no longer acceptable now. He suggested that some of the strength exercises involving back bending of trunk; uterine bends and spine exercises are not suggested for women. These exercises many cause serious injuries to women. The strength training programme for women should be extensive in nature i.e. intensity should be low and number of sets/repetitions should be higher.

Strength training brings about following changes in the body composition of females:

a) Little or no change in total body weight.
b) Significant loss of relative or absolute body fat.
c) A significant gain in lean body weight.

While the above change take place both in males and females but changes in relative and absolute body fat tend to be higher in females but increase in lean body weight is less in females as compared to males. It is an accepted fact that women cannot become as powerful as men. However, the gap can be made smaller by strength training. The general belief is that if women

do too much of strength training, it can damage women's body causing conditions like prolapse of the womb and difficult pregnancies. However, there is little evidence to support this belief.

Suggestions for Prevention of Physical Damage and Injuries

Strength training puts high demand on muscles, tendons, ligaments and joints and therefore, it is important that these demands be carefully met and in no case these demands should exceed the capacity of the sportsperson. During each training session for development of strength, the coach should maintain constant vigil and ensure proper supervision to prevent sportspersons from possible injuries. While working with strength training equipment, sportspersons shall maintain proper discipline in order to prevent accidents. To ensure proper training, close cooperation must exist between coach, sportsperson and sports doctor.

The following suggestions must be adhered to in order to prevent physical damages and injuries.

1. Do not perform strength training with weight without qualified supervision.

2. To reduce chance of injury, keep head and limbs clear of weights and moving parts at all times.

3. Proper skill is needed while working with heavy apparatus during each session of strength training. In the beginning the strength exercise should be correctly learnt with lighter weights and as the skill improves, the resistance should be gradually increased.

4. A variety of exercises should be performed. The weak joints of the body namely, hand, foot and elbow should not be loaded with heavy weights.

5. In all the strength training exercises, the spine should be kept straight and avoid frequent stress on the spine during one training session.

6. While performing strength exercise, the normal breathing should continue. Avoid holding of breath for too long.

7. Each strength training session must be preceded by a good session of warming up and must end with limbering down.

8. As soon as pain is experienced in muscles and joints, the exercises should be stopped. This way prevents in protecting serious injuries.

9. Take preventive measures in order to protect muscles, ligaments and joints from injuries. Steps should be taken to accelerate recovery after each session of strength training.

10. While working with heavy weights take help of assistants and use proper footwear in order to stabilize the foot joints.
11. Strength training equipment to be used must be free from defects.

12 Observe proper discipline and follow safety rules in each strength training session.

When one of the motor components is not trained for a certain period of time, it returns to its pre-trained state. The rate of regression depends upon the motor

component and the procedure adopted for training the component. Paish (1998) is of the view that strength regresses the quickest and skill the slowest. A detailed analysis of the above statement clearly reveals that in as much as the strength regresses the quickest, all other motor components namely speed, endurance, flexibility, agility, skill etc. will also regress because all these components are dependent on strength. In other words if strength is reduced, the total performance of the sportspersons will go down.

WEIGHT TRAINING

Key to the development of muscular strength is the progressive resistance training, which can be best, achieved through selected weight training exercises. A group of 6 to 8 exercises with varying sets and repetitions involving different parts of the body is usually included in a programme of weight training. In weight training, repetition refers to the number of times a resistance is over-come and a set is the period during which the required number of repetitions are to be performed without the weight beings put down. To start with, the weight should be so adjusted as may be comfortably overcome by an individual and as the strength improves the weight could be correspondingly increased.

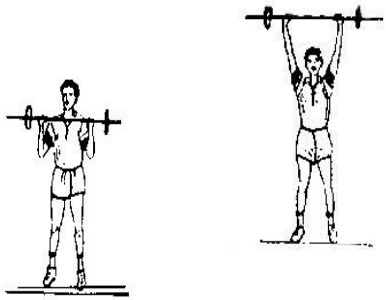
Some people have the idea that strength is something needed only by males. The general misconception is that if females work on strength training schedules, they will have bulging muscles. This viewpoint is incorrect. In fact the hormones in the body of the females prevent them from developing bulging muscles. Females who do regular strength training for

general fitness development are more likely to develop better contours and look more attractive and beautiful.

For developing strength of various muscles or muscle groups a number of weight training exercises are available of which a person may select a few depending upon his body needs. Some of the commonly used weight training exercises is described as follows:

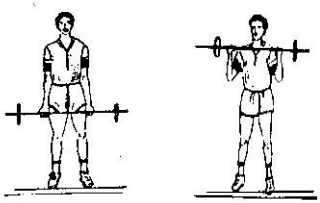
Two Arms Press

Stand with feet shoulder width apart. Hold the barbell with both hands, palms facing downward. Lift the barbell to the chest level. Keeping back and legs straight, press the barbell overhead, elbows straight. Lower the barbell to the starting position.



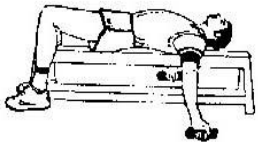
Arm Curl

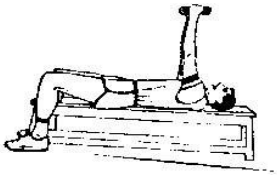
Stand with feet shoulder width apart. Grasp the barbell with both hands, palms facing upward and lift it to thigh rest position. Keep back straight; lift the barbell towards chest by flexing the elbows. Return to thigh rest position.



Supine Lateral Raise

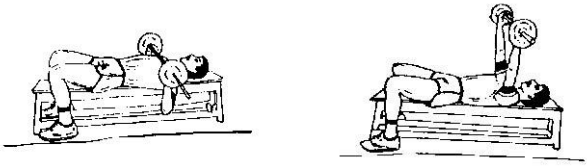
Lie on back on a bench, legs spread, feet on floor. Grasp dumbbells kept at arms length from the bench at the sides. Raise arms sideways and upward over the chest. Return to the starting position.





Bench Press

Lie supine on bench with feet flat on the floor. Grasp the barbell and keep it close to the chest with elbows flexed. Press up straight, arms completely straight. Return slowly to the starting position.

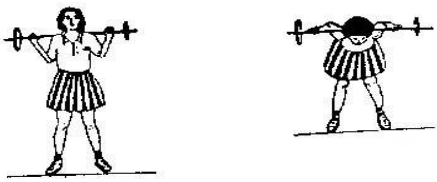


Prone Lateral Raise

Lie on the belly on a bench. Legs spread to sides, feet on floor. Hold dumbbells kept at arms length on both sides of the bench. Raise the dumbbells sideward to shoulder height, keeping elbows extended. Return to starting position.

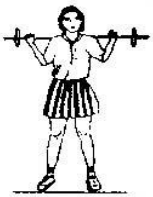
Good Morning

Stand erect with feet shoulder width apart and place the barbell over the shoulders behind the neck. Bend forward until trunk is parallel to the ground. Return to the starting position.



Half Squat

Stand erect with feet shoulder width apart and place the barbell over the shoulder behind the neck. Keeping back straight bend the knees so that thighs are approximately parallel to the ground. Return to the starting position.

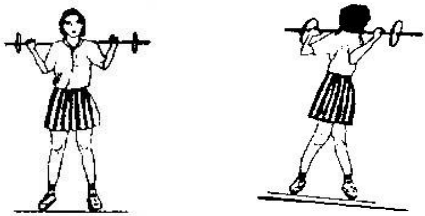


Step Ups

Stand near a bench with feet slightly apart, barbell on the shoulder behind the neck. Step over the bench with left foot, climb and join the right foot, keep knees and body straight. Step down with the right foot and join the other foot to come to the starting position.

Trunk Twist

Stand with feet shoulder width apart and place barbell over the shoulder behind the neck. Twist the trunk to the left and then to the right.



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these components are dependent on strength. In other words if strength is reduced, the total performance of the sportspersons will go down.

ISOKINETIC TRAINING

The characteristics of using machines for weight training are the following:

1. The primary advantage that machines have over free weights is safety. The weights cannot drop or fall on the player.
2. The body must be properly fitted into a machine before performing any exercise. Seats and levers should be adjusted to fit the player's body size.
3. If seat belts are available in the machine, the performer should use them.
4. The players should always position themselves in a straight, aligned manner.
5. The player should avoid twisting or shifting the weight during any exercise.
6. If a machine has grips, the player should grasp them with a loose, comfortable grip.
7. Avoid any sudden or jerky movements.
8. If the player has a chronic injury, he may have to avoid certain exercise machines.
9. Never use machines you don't know. Ask an instructor to show you how.
10. Do not use a machine that is not functioning smoothly.
11. Use towels or extra seat pads to reduce stress.
12. Exercises, which can be performed using multi-station weight machines include: leg press, bench press, shoulder press, leg curls, etc.

Modes of Strength Training

(with emphasis on isokinetic strength training system)

Two basic types of training methods are used to improve strength: isometric and isotonic. Isometric or static training refers to a muscular contraction producing little or no movement, such as pushing or pulling against immovable objects. Isotonic or dynamic training refers to a muscular contraction with movement, such as lifting an object over the head. Isotonic training programs can be conducted without weights or with free weights (barbells and dumbbells), fixed resistance machines, variable resistance machines, and isokinetic equipment.

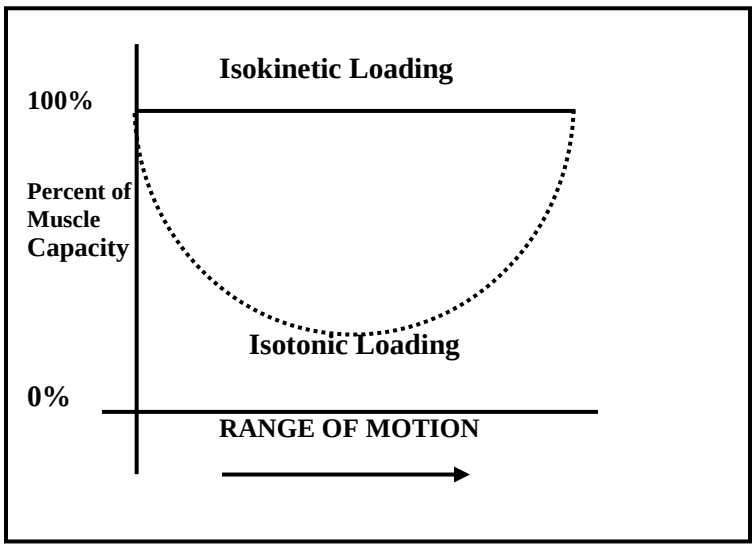
When a person performs isotonic exercises without weights (e.g., pull-ups, push-ups), with free weights, or with fixed resistance machines, a motion moves through its range of motion. The greatest resistance (weight) that can be lifted equals the maximum weight that can be moved at the weakest angle of the joint. As the popularity of strength training increased, new strength-training machines were developed. This new technology brought about the introduction of isokinetic and variable resistance training. These training programmes require the use of special machines equipped with electronic/mechanical devices that provide a variable resistance, with the intent of overloading the muscle group maximally through the entire range of motion. A distinction of isokinetic training is that the speed of the muscular contraction is kept constant because the machine provides an accommodating resistance to match the user's force through the range of motion.

The mode of training used by an individual depends largely on the type of equipment available and

the specific objective that the training programme is attempting to accomplish. Isometric training does not require much equipment and was commonly used several years ago, but its popularity has significantly decreased in recent years. Since strength gains with isometric training are specific to the angle at which the contraction is being performed, this type of training is beneficial in a sport like gymnastics, where static contractions (e.g., handstands, iron cross, "L" supports) are regularly used during routines.

In joint motion, the muscles controlling the movement have points at which strength is greater and points where it is less. For example, the greatest tension or strength of the elbow flexors (biceps, brachialis) is at 120^0 with the least tension and strength at 30^0. In true isokinetic exercise, the resistance adjusts so that it is exactly matched to the force applied by the muscle throughout the full range of joint motion. This means that the muscle can apply maximal tension during the entire left. This is accomplished by controlling the speed of the movement.

ISOKINETIC VS. ISOTONIC EXERCISE



During isotonic muscle contraction, the amount of weight that can be utilized must be adjusted to the weakest point of the lift. Thus the muscle is not operating at 100 percent capacity during all parts of the lift. With isokinetic exercise, the specialized equipment allows the muscle to contract maximally throughout the entire range of motion.

Isotonic training is the most popular mode used in strength training. The primary advantage is that strength gains occur through the full range of motion. Most daily activities are isotonic in nature. We are constantly lifting, pushing, and pulling objects, where strength is needed through a complete range of motion. Another advantage is that improvements are easily measured by the amount lifted.

The benefits of isokinetic and variable resistance training are better than the isotonic training methods. Theoretically, strength gains should be better because maximum resistance is applied at the angles. Specific speeds used in various sport skills can be more closely duplicated with isokinetic strength training, which may enhance performance (specificity of training). A disadvantage is that the equipment is not readily available to many people.

Isokinetic Machine is a computer controlled exercise system, which is used for the following purposes:

1. Evaluation of muscle strength.
2. Muscle strength training.
3. Assessment of force capabilities of a joint under dynamic conditions.

4. Detection of muscular imbalances.
5. Correction of muscular imbalances.

The isokinetic muscles strength testing equipment comprises of:

1. Central Control Module
2. Multi Joint Module
3. Standard Adaptors for Multi Joint System
   - i) Long Base Adapter for Shoulder, Hip, Knee, Hand and Elbow
   - ii) Knee Adapter with base adapter, long for Knee Extension and Flexion, Shoulder rotation.
   - iii) Hip Adapter with base adapter, long Hip Extension and Flexion, Abduction and Adduction.
   - iv) Shoulder Adapter with base Adapter long for Shoulder Extension and Flexion, Abduction and Adduction.
   - v) Shoulder Rotation Adapter with base Adapter, long and Knee Adapter for Shoulder rotation and Elbow Extension and Flexion.
   - vi) Short Base Adapter for Hand Extension and Flexion, Elbow Sup/Pro. Ankle).
   - vii) Ankle Adapter with Base Adapter short for all ankle movements as well as for hip rotation.

4. Stabilization Equipment for Multi Joint System

Training Means

Different variables and measures, which help in the attainment of high sports performance, are termed as training means. High sports performance is

facilitated only if the training means adopted are scientific, systematic, well planned and organized. Different forms of physical exercises (general, special and competitive) and other additional means of training namely pedagogical variables, psychological means, physio-therapeutic means, bio-mechanical means, natural means and numerous material objects represent various means used in the training of sportspersons. A brief description of the training means is as follows:

I Principal Means of Training

1. Physical Exercises

Physical exercises are the main and the most important means of training and without these the performance capacity of a sportspersons cannot be enhanced. The additional means of training enhance the effect of physical exercises and can be used separately or along with physical exercises, as per the requirements. The physical exercises bring about direct effect on performance whereas the additional means of training lead to in direct effect. In as much as the physical exercises are available in very large numbers, it is important for a coach and sportspersons to know their specific effects. Since an exercise can have varied effects in different games and sports, therefore their utility and importance should be considered in relation to a particular sport or a game. The physical exercises can be classified as:

i) General Exercises

These exercises focus on the development of total muscular system and enhance the general physical fitness of a sportsperson for the purpose of general athletic development. These exercises lay down the base for specific and competitive exercises. In addition they improve general coordination, skills and general tactical

efficiency. They also help in developing general psychic abilities needed for training and competition. Keeping the above purposes in mind these exercise are mainly performed during the preparatory period. In as much as these exercises help in recovery and relaxation, in addition to preparatory period these are also performed during competition and transition periods to facilitate quick recovery and relaxation.

ii) Special Exercises

These exercises focus on the development of those muscles and motor abilities, which have a direct relevance to the skills of the sport. They also help in improving the tactical skills and tactical efficiency. For above development these exercises are performed during the preparatory period and for the maintenance above factors these exercises are also done during competition period. They also have role in developing specific psychic abilities for sports and for developing this aspect they can also be done during preparatory as well as during competition periods.

iii) Competitive Exercises

In case the load structure (degree of psychic, physical and physiological load) and movement structure (technique of movement) of an exercise is same or nearly same to that of competition activity then the exercise is called a competition exercise.

Examples of physical exercises in some sports are given in the following table.

Sport	**General Exercise**	**Special Exercise**	**Competitive Exercise**
Long jump	Free hand exercises, Basketball,	Explosive strength training	Build up competition, trials,

	Volleyball, Cycling etc.	exercises for developing quadriceps, perfection of approach run for take off.	practice of full long jump movement with slight modification.
Football	Free hand exercises, Continuous running, Swimming, Gymnastics, Hockey etc.	Exercises for improving legs explosive strength, specific conditioning exercises, lead up activities with football.	Competition, playing the game on smaller or bigger play field at competitive intensity, playing with less players.

Wrestling	Strength training exercises for different muscles of the body, Swimming, Hockey etc.	Specific free hand exercises, exercises for developing strength endurance of arms and legs.	Competition bouts with lighter and heavier opponent, participating in wrestling bouts of shorter and longer rounds.
Basketball	Strength training exercises for different muscles of the body, Volleyball, Swimming, Football	Learning of skills and tactics, specific conditioning exercises, exercises for development of explosive	Competition, playing game with less number of players for shorter and longer duration with minor

	etc.	strength of legs, lead up activities.	variation in the pace.

II Additional Means of Training

1. Pedagogical variables

This includes various instructional procedures adopted by the coaches for creating the movement concept, imparting of feedback knowledge, development of mental abilities and active participation, creation of interest and motivation and development of all-round personality of the sportspersons.

2. Psychological means

This involves various psychological interventions namely ideo-motor training, autogenous training, psycho-tonic training, progressive relaxation training etc. for enhancing skills and tactical efficiency, for acceleration of recovery and relaxation, control of behaviour of sportspersons during training and competition, removal of fear and psychic preparation.

3. Physio-therapeutic means

This category includes such measures as proper nutrition for health, recovery and relaxation, hygienic measures for prevention from infections, massage and physiotherapy for treatment of injuries and rehabilitation and bio-chemical tests for determining the effect of training.

4. Bio-mechanical means

This includes various bio-mechanical methods such as cinematography, videography, dynamography and other measuring devices used for perfection of skill and identification of faults, assessment of force and measurement of other kinematic and kinetic variables.

5. Natural means

This includes various environmental factors such as weather conditions, altitude, air, water and other similar natural means, which have an effect on training load and also have an influence on various physical as well as physiological variables.

6. Material objects

This includes various audio-visual aids, training equipment and apparatus used by the coaches for creating a movement concept and providing a feedback to the sportspersons and also material objects used for teaching skills, developing physical fitness and improving tactical efficiency.

Chapter 3.2

Endurance

Endurance is characterized by the maintenance of working capacity and by the degree of resistance of the organism against fatigue and against the influence of unfavorable recovery after a tiresome activity. Endurance loads cause numerous changes in the functions and structure of the organism. These changes refer to the performance of heart, circulation, respiration, metabolism, hormonal system and bio-chemical changes in the muscle cells.

Benefits of Endurance

Endurance is an important conditional ability. It is primarily determined by energy liberation processes. The ability of the individual to maintain a certain load of energy production forms the physiological basis of endurance. Performance in endurance activities does not depend only on physiological factors but also on the will qualities of the sportsperson. The benefits of endurance are discussed as under:

1. Endurance facilitates maintenance of pace and tempo of an activity during training and competition.
2. Endurance is necessary for good quality of sports technique.
3. Endurance enables sportspersons to successfully complete training schedules of high loads.
4. Endurance facilitates maintenance of working capacity and thus enables a person to continue activity for a prolonged period of time.
5. Endurance helps in delaying the onset of fatigue and to recover quickly from fatigue during competition and training.

6. Endurance enables a sportsperson to maintain rhythm, concentration and mental alertness during training and competition.
7. Endurance helps in the maintenance of good health, improves resistance of the body against general infections and cures various cardio-respiratory diseases and metabolic disorders.

In games and sports, there are different types of loads and situations, which make specific demands on endurance:

1. Loads with maximum speed and maximum motor frequency (sprints).
2. Loads with sub-maximum speed over a maximum space of time with mainly anaerobic gaining of energy. (Middle distance events).
3. Loads with medium speed over a longer time with mainly aerobic gaining of energy (Long distance events).
4. Loads with alternating speed or changeable pace. (Games and sports, wrestling, boxing, judo etc.)
5. Sports involving static continuous effort (Shooting, archery, gymnastics etc).

Forms of Endurance

Endurance can be classified based on the nature of the activity and duration of the activity. Keeping in mind the nature of the activity, the endurance can be classified into following four types:

1. Basic endurance
2. Speed endurance
3. Sprint endurance
4. Strength endurance

Basic Endurance

It is the ability of the organism to resist against fatigue in the case of endurance loads of medium intensity of stimulus and mainly aerobic muscular metabolism.

Speed Endurance

It is the ability of the organism to resist against fatigue in the case of endurance clods of sub-maximum intensity of stimulus and mainly anaerobic gaining of energy and maximum loss of oxygen.

Spring Endurance

It is the ability of the organism to resist against fatigue during endurance load of maximum intensity and maximum motor frequency.

Strength Endurance

It is the ability to the muscle to get over resistance in the cased of loads of medium intensity of stimulus for as long time as possible.

Factors Determining Endurance

Endurance ability depends upon the following factors:

1. Aerobic Capacity

Aerobic means "with oxygen" and to enable a person to continue an activity for a prolonged period, continuous flow of oxygen has to be ensured to the working muscle for liberation of energy. The aerobic capacity of a person can be measured by the maximum amount of oxygen consumed by the working muscles in one minute (VO_2 max).

The aerobic capacity (VO_2 max)of a person depends upon the following factors:

a) Amount of oxygen that can be extracted by the blood from the atmosphere.
b) Amount of oxygen that can be transported from the lungs to the working muscle.
c) Amount of oxygen taken up by the muscle cells from the blood.
d) Amount of glycogen stores in the muscles and liver.

2. Anaerobic Capacity

Anaerobic means "without oxygen" and it is the ability of the organism to perform an activity in the absence of oxygen. For these activities energy production comes either from breakdown of phosphogen (ATP and CP) or from glycolysis of muscle glycogen. The process of production of energy due to breakdown of ATP and CP is termed as alactacid mechanism and production of energy due to glycolysis of muscles glycogen is called lactacid mechanism. The amount of phosphogen stores in the muscles is limited and can supply oxygen for high intensity activity lasting for 8 to 10 seconds. Hence alactacid mechanism supports continuance of high speed activities.

Anaerobic capacity depends upon the following factors:

a) Adenosine triphosphate and creative phosphate stores in the body (Phosphogen Stores).
b) Ability of the alkali reserves of the body to neutralize lactic acid (Buffer Capacity).
c) Ability of the individual to tolerate high concentration of lactic acid in the blood and muscles (Lactic Acid Tolerance).
d) Amount of oxygen consumed by the working of muscles per minute (VO_2 max).

3. Economy of Movement

All the movements are to be efficiently executed and unwanted movements are to be avoided so that activities are performed with minimum expenditure of energy. To achieve this, complete technical efficiency is to be ensured. A sportsperson who can perform an activity with less expenditure of energy can continue with same speed for longer duration.

4. Psychological Factors

In addition to physiological factors, certain psychological factors namely motivation, will power, ability to tolerate pain and discomfort etc. are also important in enabling a sportsperson to continue activity for a prolonged period.

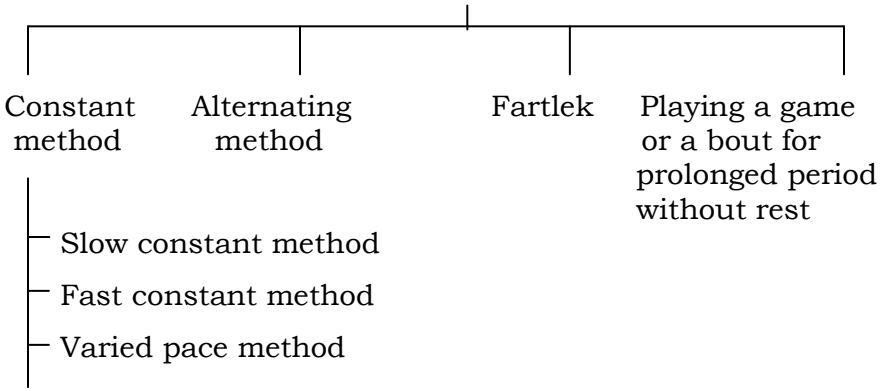
Methods of sports training are systematically planned and effective procedures adopted for the formulation of training process and are characterized by utilization of methods for imparting training content so as to ensure development of performance. Application of effective and well-planned methods of sports training guarantees attainment of training contents as well as tackling of various training tasks. In training numerous training methods are used for improving the performance of a sportsperson. These are: methods for improving different motor abilities (strength, speed, endurance and flexibility) and methods for techniques and tactical training as well as intellectual development of the sportsperson. The following basic methods of conditioning have been discussed in this chapter:

1. Methods based on continuous principle
2. Methods based on interval principle
3. Circuit training
4. Weight training

1. Methods based on continuous (uninterrupted) load principle

These methods are also termed as duration load methods, which include those methods of training in which uninterrupted medium to sub-maximum intensity loads are maintained for a relatively longer period of time. These methods can be classified as follows:

Duration Load Methods



a) This method involves continuous loads administered for a prolonged period of time. In as much as the loads are continued for a long time, the intensity of running is low. This method has three variations.

i) Slow Constant Method

In this method the intensity of running is such that as a result of undertaking the training load the heart rate increases from normal to between 140-160 beats per minute. In order to produce best results, the volume of load in terms of duration should not be less than 30 minutes. The maximum duration can even go up to 120 minutes in the case of trained sportspersons. This method improves glycogen stores of the body,

improves capillarisation, improves quality of alkali reserves of the body, improves thermoregulation and brings about efficiency of movements. This method also enhances will power and determination of the sportsperson.

ii) Fast Constant Method

In this method, the intensity of running is such that as a result of administration of training load, the heart rate increases from normal value to between 160-180 beats per minute. The volume of load in terms of duration should not be less than 20 minutes. This method is effective for enhancing VO_2 max, oxygen extraction ability of the muscle, increased number and size of mitochondria and quality of enzymes. In addition, this method also brings about changes in the heart and lungs.

iii) Varied Pace Method

This method also involves application of uninterrupted loads but with change of pace or spread. In this method the sportsperson starts with fast constant method first and continues about 15 minutes and then switches over to slow constant method for the remaining 45 minutes. During this period of undertaking of load, the heart rate is maintained between 140 to 180 beats per minute. This method is beneficial for improving both aerobic and anaerobic capacities.

b) Alternating Method

In this method of endurance training also the load is uninterrupted but the intensity of running is changed. The coach fixes the change of intensity. In view of the fact that the coach plans intensity of running and its change, this method has not become popular. Invariably sportsperson

are unable to maintain intensity of running planned by the coach.

c) Fartlek

Fartlek is a Swedish term meaning “speed play”. This method was developed in Scandinavia to provide an alternative to constant running. It is used to describe cross country runs where the steady speed of ordinary cross country running is changed into a mixture of faster and slower phases, each covering a different distance over natural terrain according to the individual approach of the sportsperson. The change of intensity is done depending upon the surface of running, surroundings, condition of the sportsperson, climate and the like. In Scandinavia, special tracts were developing for using this method effectively. The terrain selected was such that it involved running on different surfaces, running through the woods, running by the river or sea side, running up and down the hill etc. This method is effective for developing both aerobic and anaerobic capacities of sportspersons.

An example of training schedule using Fartlek is as follows:

1. Warm up by jogging for 5 to 10 minutes followed by free hand exercise (calisthenics) for different parts of the body for about 4 to 6 minutes.
2. Run at fast steady pace over a distance of 800m to 1200m.
3. Brisk walking for 5 minutes
4. Perform easy running, separated by 40 to 50 meters sprints, repeating until symptoms of fatigue appear.

5. Slow jogging for about 3 to 5 minutes.
6. Run up the hill at full speed over a distance of 80 to 100 meters. Run down the hill at a jogging pace after each repetition.
7. Walk for 5 minutes.
8. Run at fast pace for about one minute.
9. Jog about 1 to 1.5km. to limber down.
10. End with free hand and stretching exercises.

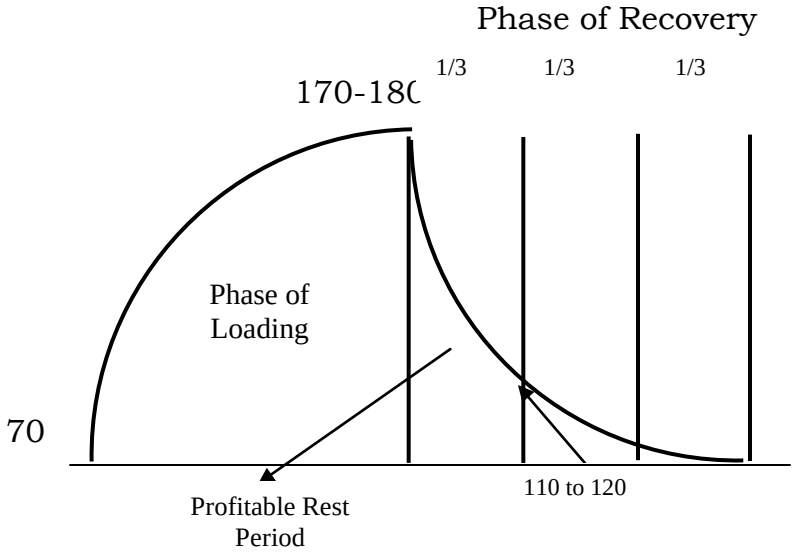
Effects of Duration Load Methods

Method	Physiological Effect	Training Effect	Psychological Effect
Continuous Method	• Improves efficiency of cardio respiratory system. • Development of aerobic capacity • Development of anaerobic capacity • Increased VO_2max • Increased muscle glycogen • Capillarisation • Improved compensation capacity.	• Development of basic endurance • Development of strength endurance	• Improvement of determination and will power. • Enhancement of tolerance ability in respect of pain and discomfort.

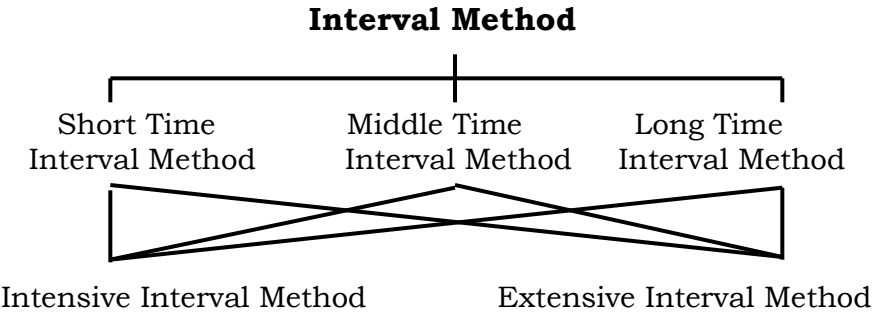
Interval Method

It is perhaps the most versatile method of endurance training, which involves repeated efforts art at a relatively faster pace separated by measured intervals of incomplete recovery. The intensity of each

bout of running should be such that the heart rate increase from normal to between 170 to 180 beats per minute. The bouts of loads are repeated when the heart rate comes down from the above value to about 120 beats per minute. The training load in this method is best maintained by repeatedly checking the heart rate.



The interval method can be classified as follows:



a) Short Time Interval Method: In this method the duration of each bout of load is between 15 sec. to 2 minutes.
b) Middle Time Interval Method: In this method the duration of each bout of load is between 2 to 8 minutes.
c) Long Time Interval Method: In this method the duration of each bout of load is between 8 to 15 minutes.

The above three variations of interval method can be categorized into intensive internal method and extensive interval method. The intensive interval method is dominated by high intensity (80% to 90%). The extensive interval method dominated by volume of stimulus and intensity is comparatively less (60% to 80%).

Factors of Interval Method

1. Intensity of stimulus (speed of work)
2. Density of stimulus (interval of recovery)
3. Duration of stimulus (duration of work)
4. Frequency of stimulus (number of repetitions)
5. Mode of recovery (nature of recovery)

The above factors can be manipulated to increase or decrease the load. Manipulating only one of the above factors or even all the factors can increase this load. The important point to be recognized is the mode of performing recovery. Between two bouts of load, walking or jogging or combination of walking and jogging could perform the recovery. Sitting and lying between two repetitions of training load are not recommended.

Interval running method has been recommended for improving specific endurance in cyclic sports e.g. track and field events, swimming events, cycling and

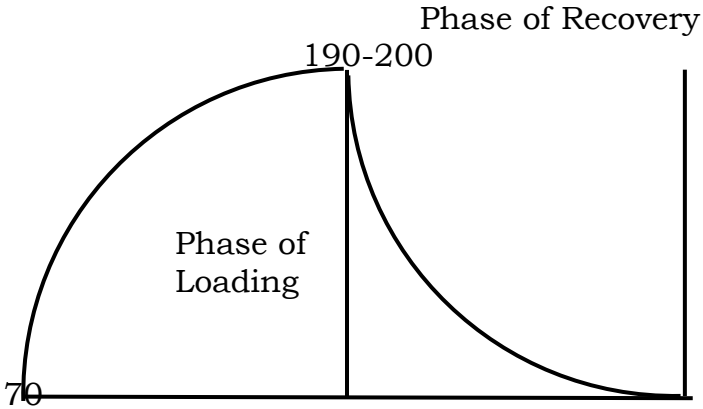
the like. This method has been also used to the best advantage in improving specific endurance in different team games, combative and racket sports.

Effects of Interval Method

Method	Physiological Effect	Training Effect	Psychological Effect
Interval Method i) Intensive Method	• Improves efficiency of cardio respiratory system. • Development of aerobic capacity • Development of anaerobic capacity • Increased VO_2max • Increased muscle glycogen • Capillarization • Improved compensation capacity.	• Development of basic endurance • Development of strength endurance • Development of strength	• Improvement of determination and will power. • Enhancement of tolerance ability in respect of pain and discomfort. • Enhanced ability to work under fatigue conditions.
ii) Extensive Method	• Improves efficiency of cardio respiratory system. • Hypertrophy of heart • Hypertrophy of skeletal muscles • Development of aerobic capacity • Development of anaerobic capacity • Increased VO_2max • Increased muscle glycogen • Capillarization • Improved compensation capacity • Increase ATP and CP reserves	• Development of speed and strength endurance. • Development of explosive strength • Development of maximum strength	• Improvement of determination and will power. • Enhancement of tolerance ability in respect of pain and discomfort. • Enhanced ability to work under fatigue conditions.

Repetition Training Method

This method involves load of high intensity (90% to 100%) of stimulus separated by intervals of complete recovery. It is considered as the best method for developing speed endurance and pace judgement. This method enhances anaerobic capacity this improving phosphogen stores, lactic acid tolerance and non-oxidative enzymes.

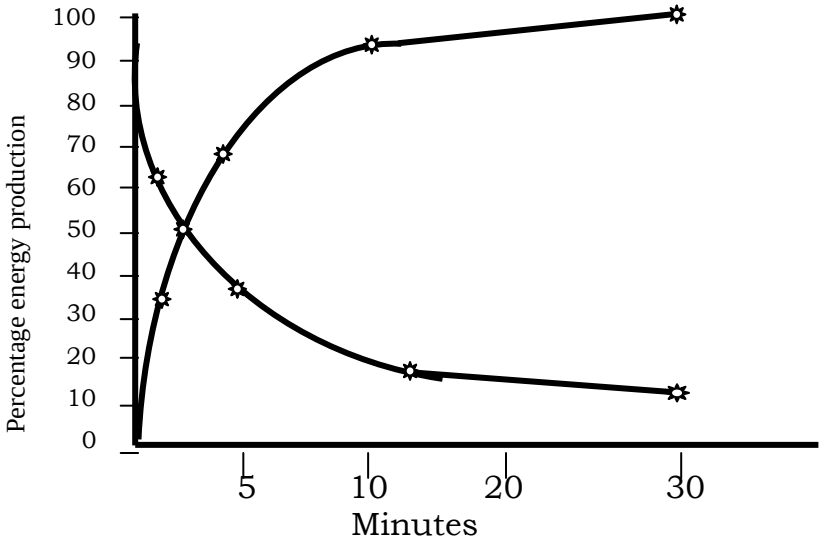


Interval Method		Rep. Trg. Method
70-80%	Intensity	90-100%
1-3 min.	Density	2-10mins.
1-10mins	Duration	10 secs-2mins.
High	Frequency	Low
Walk/jog	Type of recovery	Walk/jog

Effects of Repetition Training Method

Method	Physiological Effect	Training Effect	Psychological Effect
Repetition Training Method	• Improves efficiency of cardio respiratory system. • Development of anaerobic capacity • Increased VO_2max • Increased muscle glycogen • Improved ATP and CP stores • Improved lactic acid tolerance capacity • Improved compensation capacity. • Improved neuromuscular coordination	• Development of speed • Development of speed endurance • Development of explosive and maximum strength	• Improvement of determination and will power. • Enhancement of competition load tolerance ability. • Psychic preparedness to put up maximum performance.

It refers to how much the aerobic and anaerobic energy systems are involved in a particular activity. Marathon runners, for example, produce most of their energy aerobically, while games, which is speed dominating depend more on anaerobic sources. The aerobic-anaerobic split is determined by identifying how long and how hard out sportsperson work without rest.

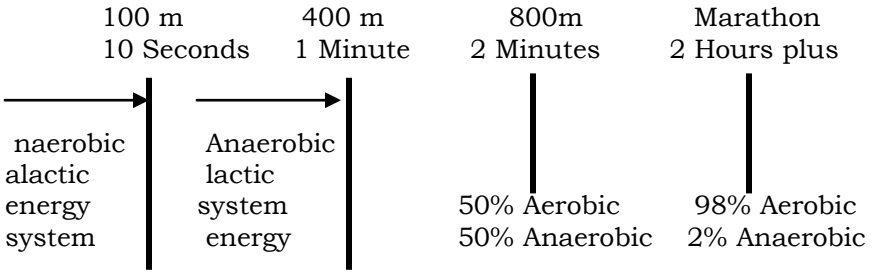


Contribution of energy systems to time of movement

There are two important work times that mark a shift in emphasis from one of the three energy systems to another:

10 seconds: After 10 seconds of intense muscular activity the energy system providing the majority of the energy shifts from the anaerobic alactic to the anaerobic lactic system.

1 minute: After about 1 minute of intense activity the shift is away from the anaerobic lactic system to the aerobic system.



Aerobic Energy

The endurance energy system

The aerobic system requires oxygen. This system is used in lower intensity exercise and is the basic system, which provides the energy for most human activity. As such it is also important in recovery from exercise of all intensity. It is very efficient and does not produce fatigue producing waste products. The heart and lungs are important in aerobic activity as oxygen and fuel are carried to the muscles in the blood. Training the aerobic system must be a minimum of 20 minutes duration. The workload for aerobic training can be either continuous or broken up into intervals of harder and easier running.

Anaerobic Alactic Energy

The 'First 10 Seconds' Energy

The anaerobic alactic system is the one referred to as the stored or start up energy system. This system provides the majority of energy when out sportspersons do bursts of high sped or high resistance movements lasting up to 10 seconds. The stores of energy in the muscle, which are used up in the intense burst of activity return to normal levels within 2-3 minutes of

rest. The anaerobic alactic energy system is developed by alternating periods of work and rest. The work time should be very intense, but not exceed 10 seconds, as this is the limit of the energy system. The rest periods should be 1 ½ to 3 minutes, depending on the duration of intense activity, to allow the muscle energy stores to build up again. If a sportspersons shows the effects of fatigue, allow more rest time or decrease the work time.

Anaerobic Lactic Energy

The ’10 Seconds to One Minute’ Energy System

This energy system is capable of high levels of intensity, but this intensity prevents the removal of waste products because not enough oxygen is available. The system operates without oxygen. As a result lactic acid accumulates within muscle cells and blood. This is a major cause of fatigue, which eventually slows the sportsperson. Getting rid of lactic acid after activity is a much slower process than the replacement of energy stores in the anaerobic alactic system. It may take more than one hour for lactic acid levels to return to their pre-exercise level. Light activity such as walking or jogging following intense efforts speeds up the removal of lactic acid. The first ten minutes of active recovery produces the greatest reduction in lactic acid levels. The anaerobic lactic energy system is developed by intense workloads of 10 seconds to two minutes duration. Rest periods will depend on the duration of the work and should be three to ten minutes to allow removal of most of the lactic acid produced.

Development of the three-energy systems

	Anaerobic Alactic	**Anaerobic Lactic**	**Aerobic**
Duration	0-10 secs	10 secs – 1min	1-60mins +
Distance	20m –18m	80m –400m	300m-15km or continuous runs
Intensity	Maximal	90% - 100%	50%-75%
Repetitions	3-4	1-5	3-20
Recovery	1½ -3 mins	2-10 mins	1-3 mins
Sets	1-4	1-4	1-4
Recovery	8-10 mins	10-20 mins	5-8 mins

Target Training Zone

It is a zone up to which the heart rate is to be enhanced from the normal value so as to ensure that the exercise under taken produces maximum training effect on the sportsperson.

Sports training is an individual process. In order to be effective, the training loads shall be administered to the sportspersons based on their special characteristics namely age, training age, load taking capacity, ability to recover, training state, talent and psychological factors like personality, intelligence and temperament. In the light of this principle it is important on the part of the coach to separately workout training loads for each of his sportsperson. If the above principle were not adhered to, the training load in terms of stimulus intensity would either be too low or too high for the sportsperson thus not providing him benefit in terms of effort put in by the sportsperson.

Selection of Variables

Numerous methods are available for computing training intensity so as to ensure optimum development of endurance. The most convenient method is the one suggested by Dr. M. Karvonen (1957) of Scandinavia. His formula utilizes only two simple variables namely age and resting heart rate. A coach, so as to guarantee maximum improvement in performance can easily adopt this procedure being simple.

1. Age: A fraction of less than 6 months is reduced to the lower age and a fraction of more than 6 months is counted as the next higher age in completed years.

2. Resting Heart Rate: The resting heart rate (RHR) is obtained in the morning while the subject is in a sitting position. The reading is taken at the carotid artery after the subject has emptied the bladder and thereafter sat quietly for a few minutes. The reading is taken for one complete minute. This is done on three mornings in a row and then the values are averaged.

The procedure adopted for the calculation of target training zone is as follows:

a) Estimation of maximal heart rate (MHR). This is done using the following formula.
   MHR = 220 - age
b) Next the heart rate reserve (HRR) is determined from the maximal heart rate using the following formula.
   HRR = MHR - RHR

c) The target-training zone for 70% and 85% training intensities (TI) is computed using the following procedure.

The heart rate reserve is multiplied by the respective training intensity percentage (70% and 85%) and then the resting heart rate is added.

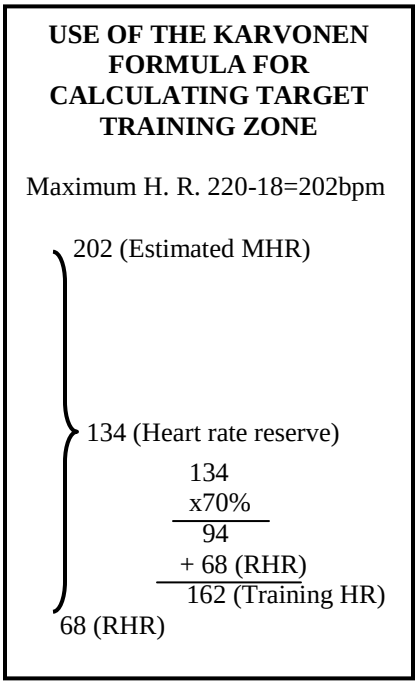
70% TI = (HRR x .70) + RHR

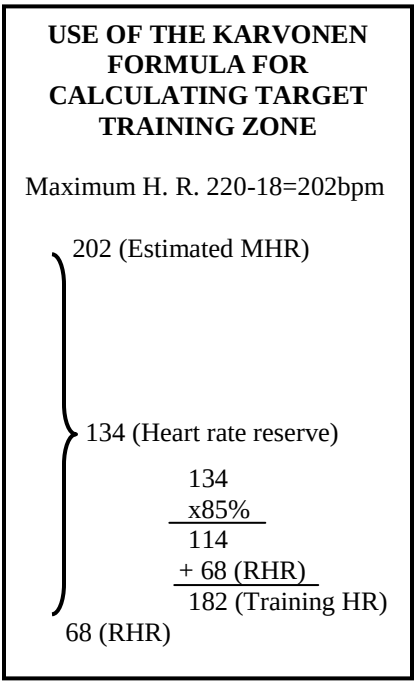
85% TI = (HRR x .85) + RHR

Note: Experienced coaches have opined that for the best development of endurance, the intensity range of 70% to 85% is considered ideal.

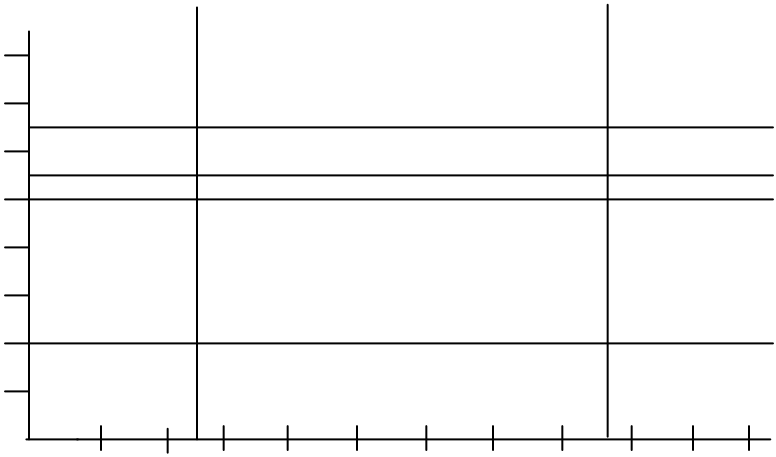
The target-training zone of each sportsperson is found between the above two target heart rates.

Example: calculation of target training zone for a sportsperson whose age is 18 years and resting heart rate is 68bpm.





1. Maximum Heart Rate (MHR)- 220-18=202bpm
2. Heart Rate Reserve- 202-68=134
3. Target for 70% training intensity-
   (134 x 0.7)+ 68=161.8 or 162bpm
4. Target for 70% training intensity-
   (134 x 0.85)+ 68=181.9 or 182bpm



Chapter 3.3

Speed

Speed is used in sports for such muscle reactions (motor movements) that are characterized by maximally quick alternation of contraction and relaxation of muscles. It is also the ability to execute motor actions, under given conditions, in minimum possible time. Speed ability is highly movement specific. Like strength and endurance, speed is also a conditional ability but unlike those two conditional abilities (strength and endurance) speed depends to a considerable extent on the nervous system. As a result of this speed is more complex in nature and is comparatively less trainable as compared to strength and endurance. The efficiency of the nervous system, which can be influenced only to a limited extent, becomes a limiting factor in the development of speed.

Fundamentals of Speed (Factors Determining Speed)

Speed as an important conditional ability has winder application in all games and sports (both cyclic and acyclic). The following factors determine speed:

1. Morphological Structure and Muscle Fibres

Speed is more a product of heredity than environment. A person is born with the dominance of muscle fibres capable of working at speed. Those persons who are born with dominance of fast twitch muscle (phasic) fibres are meant for speed dominating activities. Slow twitch (tonic) muscle fibres are helpful in endurance sports. The famous saying “sprinters are born” is in fact directly related to this important adage.

2. Regulating Procedure of Nervous System

Fester movements in sports are facilitated by quick alternation of contraction and relaxation of the muscles. When the agonist muscle contracts, the antagonist has to relax and vice versa. Rapid contraction and relaxation of the muscle is possible only when the motor and sensory nerves act efficient. This to a great degree depends upon the regulatory procedure of central nervous system.

3. Muscular Strength

Speed movements to a great extent depend upon explosive strength of the involved muscles. In fact development of strength indirectly enhances speed.

4. Technique

Acquisition of skill facilitates performance of movements at high speed. In fact unlearnt movements cannot be performed at a faster pace. A person who has mastery of technique is in a position to utilize his strength, flexibility etc. to the fullest extent to execute movement at high speed.

5. Elasticity and Relaxing Capacity of the Muscles

Good stretch ability of the muscles allows movement over as greater range as possible. This reduces internal resistance and thereby aids quick movements. A muscle, which relaxes fast, can contract faster subsequently.

6. Phophogen Stores and Metabolic Process

For faster movement, the muscles need supply of energy at a quicker rate. This will be possible only if the phosphogens (ATP and CP) are stored in the body in adequate amount.

7. Psychic Factors

Psychic factors are also responsible for affecting performance in speed activities. Factors such as motivation ability to relax, ability to concentrate, will power etc., are important for quick reactions.

Forms of Speed

Speed can be classified into following five types:

1. Reaction Speed

It is the ability to respond to a give stimulus as quickly as possible. The different forms of stimuli experienced in sports are visual, optic and tactile.

2. Speed of Movement

It can be defined as the maximum speed of contraction of a muscle or a chain of muscles in a single course of movements e.g., jumping, throwing, kicking etc. It depends to a great extent on explosive strength and technique.

3. Acceleration Speed

It is the ability to increase speed from jogging to running and finally sprinting. This form of speed, to a great extent, depends upon explosive strength, frequency of movement and technique.

4. Sprinting Speed (Locomotor Speed)

It can be defined as the ability to maintain maximum speed of locomotion over as long distance as possible for maximum possible duration.

5. Speed Endurance

It is defined as the ability to perform motor movements as quickly as possible, under conditions of fatigue. It is combination of speed and endurance abilities. This ability depends upon anaerobic capacity, psychic factors and level of skill.

Means of Speed Development

1. Reaction Speed

Reaction speed enables a sportsperson to react quickly and effectively to different types of stimuli i.e. visual, auditory and tactile. Research has shown that response to a tactile stimulus is the fastest and to visual stimulus is the slowest. Games and sports can be categorized as requiring simple reaction ability and complex reaction ability. Simple reaction ability is needed for games and sports where the sportspersons are aware of the stimulus and the response e.g., starts in tract and field and swimming. Complex reaction ability is required for games and sports where there is uncertainty about stimulus or response or both. This category includes team games and combat sports.

The following training means can be adopted to improve reaction speed:

a) To solve specified simple standard situation in which the attacking and defending reactions are agreed upon between the players. The actions are performed first with low, then with medium and finally with high speed.

b) To solve tasks fixed before hand in which the sportsperson concentrates at first on two, then on three, four or more different actions of attack and defense. Speed of action is gradually increased.

c) To solve tasks not fixed before hand. The sportsperson is not aware of the attacking and defending actions, which will be used. Speed of action is gradually increased.

d) To solve situations, the degree of difficulty of which is above the demands of competition (Pressure Training)

e) To solve situation in which the pause between announcement and execution is changed. Starts are given by different persons using different starting devices during training.

2. Speed of Movement

The speed of movement is important both for cyclic and acyclic sports. Good technique, explosive strength, flexibility and coordinative abilities are important pre-requisites for movement speed and hence can be indirectly developed by improving these four factors. The following direct training means can be adopted for improving speed of movement:

a) Repeating movement several times at highest possible speed. In order to make this training mean effective, feed back approach is effective. The total time of the movement is recorded and the sportsperson is informed after each repetition.

b) Practicing movements with implements, which are slightly lighter and also smaller in size. A shot putter may use 6.5 to 6.75 kg. shot for practicing movement. A rower may use the oars with slightly smaller blades.

c) Providing easier conditions for practicing movement. This can be achieved by changing the direction of throw to reduce air resistance, changing ground conditions, using gravitational force (down hill running).

d) Performing movements using faster rhythm. The movement rhythm can be made faster by using different devices e.g., clap, drum beat, music etc. The rhythm should be increased ensuring that the movement is properly performed and it should correspond to the actual rhythm of the sports movement.

3. Acceleration Speed

Acceleration speed can be increased by both direct and indirect methods. For improving acceleration ability indirectly, explosive strength, technique and flexibility are important pre-requisites. For improving acceleration speed directly, short sprints over a distance of 30 to 80 meters are the best. Henry (1952) found that a sprinter, when starts from a stationary position, achieves best speed in about 6 seconds. However, actual distance may differ from activity to activity and also on the nature of sport. The distance is run at maximum intensity. Number of repetitions is between 5 to 8. The repetitions could even be divided into two series of 3 to 4. In fact, the repetitions should be stopped as and when the sportsperson is not able to maintain maximum speed for each repetition. Between repetitions full recovery is to be ensured to facilitate performance of each bout of load at maximum intensity. In case repetitions are divided into two series, a short warm up is recommended between the two series. The mode of recovery suggested is active.

4. Sprinting Speed (Locomotor Speed)

It is the ability to maintain high intensity over maximum duration possible. The research findings as well as top coaches have opined that intensity of 99% to 100% can be maintained only over a distance of 20-25 meters. However, this distance varies depending upon the training state and age of the sportsperson. In the

case of a beginner or a less conditioned sportsperson this distance is less. Indirect development of locomotor speed can be achieved by improving the efficiency of the central nervous system even though it is less trainable. Explosive strength, technique and flexibility, which are trainable factors also improve sprinting speed indirectly.

Sprinting speed can be developed directly using the following training means:

a) Acceleration runs
b) Ins and outs
c) Differential Races.

a) Acceleration Runs

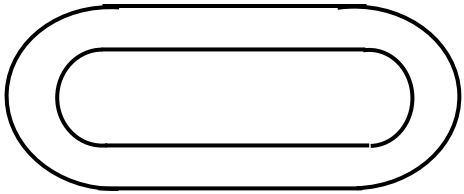
Acceleration runs are performed over a distance of 80 metres ensuring that in each repetition effort is made to reach the limit of maximum intensity (90-100). Between two repetitions full recovery is to be ensured. Total number of repetitions is between 5 to 8. Bouts of loads should be discontinued when the time of sprint starts decreases i.e. one is unable to maintain high intensity (90%-100%).

b) Ins and Outs

It is an effective method of developing spring speed. The word ins means reducing speed and the word outs means increasing speed. This method is a combination of increasing and decreasing speed over a chosen distance. A distance between 120 metres to 250 metres is chosen and divided into four to five zones of 30 to 50 metres. If one decides to have four zones of 30 metres each, the total distance required is 120 metres and for five zones of 50 metres each, the total distance needed will be 250 metres.

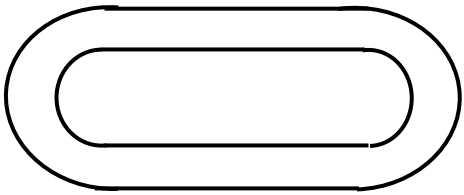
The pattern of running different zones is done as follows:

Planning for four zones



Zone-I-Zone of acceleration
Zone-II-Zone of sub-maximum to maximum intensity
Zone-III-Running without applying additional force
Zone-IV-Zone of sub-maximum to maximum intensity

Planning for five zones



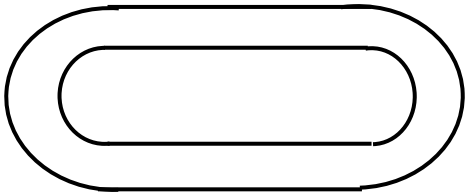
Zone-I-Zone of acceleration
Zone-II-Running without applying additional force
Zone-III- Zone of sub-maximum to maximum intensity
Zone-IV-Running without applying additional force
Zone-V- Zone of sub-maximum to maximum intensity

This training mean can be effectively planned on the track or on any open area or a play field. 4 to 6 repetitions are performed and between two repetitions full recovery is provided.

c) Differential Races

To use this training mean to the best advantage, a distance between 150 to 200 metres is used and

divided into two zones of equal distance. To plan intensity of running, the best time of the total distance chosen is recorded. The total time of the distance is assigned to two different zones is such a way that the first zone is run faster than the second zone, and the difference in the timing of the two zones is not more than one second. If one decides to choose a distance of 200 metres, it is divided into two zones of 100 metres each. Suppose the timing of running 200 metres is 25.0 seconds., it is divided in a way that first zone is run in 12.0 seconds and the second zone in 13.0 seconds.



Differential races can be systematically planned on the track or an open area or a play field. 4 to 6 repetitions are performed and between two repetitions full recovery is provided.

5. Speed Endurance

Speed endurance is a special speed quality and can be developed using both indirect and direct training means. Indirect development can be ensured by improving anaerobic capacity, technique and explosive strength. Optimal development of basic endurance is an important pre-requisite for improving speed endurance.

Speed endurance can be improved directly using the following training means:

a) Pace Races
b) Repeated High Intensity Runs

a) Pace Races

This is an effective training mean for improving speed endurance. Distances between 120 to 600 metres are repeated at high speed, a speed that can be kept constant throughout the distance. The actual distance and number of repetitions will depend upon the game or the sport and also the training state of the sportsperson. Complete recovery is to be ensured between two repetitions. If one is capable of performing several repetitions, it is advisable to run them in two series of 2 to 4 repetitions. Between two series a short warming up session is recommended.

b) Repeated High Intensity Runs

This method is recommended for developing speed endurance for team games, racket sports and combat sports. Bouts of loads over a distance of 40 to 60 metres are performed at maximum intensity. Three to four series of 4 to 5 repetitions are performed. Between two bouts of load the recovery period is short (about 20 to 30 seconds) and the rest period between two series is 3 to 5 minutes. It is also possible to develop circuit of four to eight exercises (stations), which are done at high speed. This method is highly effective in developing speed endurance for combat sports namely wrestling, judo, boxing etc.

Speed Barrier

In as much as speed training involves repeated efforts of very high intensity, after training for some time a barrier sets in due to establishment of “neural stereotype” in the nervous system which controls spatial and temporal aspects of movement. Because of high-speed training, the functioning of neural centres gets stabilized thus causing a speed barrier leading to stagnation of performance.

The problem of speed barrier can be dealt with in the following ways:

a) Delaying of Speed Barrier

The speed barrier can be delayed by improving speed using higher proportion of general speed training means as compared to specific training means. It is also possible to delay the speed barrier by developing speed using indirect training means. As a result of enhancement of technique, explosive strength and flexibility, speed can be indirectly developed. Inspite of using above means, the speed barrier will set in but at a higher level of performance.

b) Tackling of Speed Barrier

Inspite of making effort to delay the speed barrier, the barrier sets in sooner or later. When the speed barrier sets in the following means can be adopted to tackle it:

i) Dong movements at a speed higher than the best. For this sprinters can use down hill running, throwers can use lighter implements and rowers can use oars with smaller blades.

ii) Avoiding specific movements and using indirect training means for a considerable period makes the neural connection (motor stereotype) established in the nervous system weak and thus barrier can be overcome with less effort. After breaking the barrier, the sportsperson can again switch over to speed training.

Chapter 3.4

Flexibility

Flexibility, often also referred to as joint mobility or suppleness, can be defined as the ability to perform movement with greater range of motion or large amplitude. It is controlled partly by the energy liberation processes of the body and partly by the coordinative processes of central nervous system.

The type of flexibility required varies considerably from sport to sport. For example, the hurdler requires the best possible hip flexor movement, and the swimmer ankle flexibility. While some sports demand greater flexibility about one specific region, others such as gymnastics, multi-event athletics and the martial arts, require a high level of flexibility in many joints. Several sports require static or extent flexibility. However, the majority of major sports require dynamic flexibility, where the joint is forced to work at a very high speed.

Importance of Flexibility

Insufficient flexibility can lead to following difficulties:

a) The pace of acquiring and perfecting movements in sports is lengthened.
b) Sportsperson may get easily injured.
c) Sportsperson is handicapped in developing other motor qualities namely, strength, speed, endurance etc.
d) Amplitude of movement is limited and, therefore, more effort is needed to perform a movement.

Because of more effort, the sportsperson will get easily tired.

e) The course of movement is impaired its quality.

Factors Affecting Flexibility

Flexibility is affected by several factors, which are physical, anatomical and coordinative, and nature. The factors are:

a) Anatomical Structure of a Joint

A joint consists of bones, which are bound by ligaments. The bone ends and the manner in which they are joined decide the movements possible around a joint. Hinge joint (knee and elbow) permits only flexion and extension whereas ball and socket joints (shoulder and hip) allow for greater mobility.

b) Extensibility of Ligaments and Muscles

Ligaments, which are thick bands of connective tissue, provide stability to a joint. Ligaments facilitate movement around a joint yet keep the bone ends together. Ligaments have some degree of stretch ability yet they cannot be stretched like muscles. The extensibility of the ligaments is less as compared to muscles. Through training elasticity of ligaments can be enhanced but to a stretching them beyond their limit of extensibility.

Extensibility of muscles is an important factor limiting range of movement. To perform movement over greater range, the muscle can be increased to a considerable extent due to training over a period of 4 to 6 weeks.

c) State of the Organism

Flexibility of a person is less when he gets up in the morning, when he is under some psychic depression or when his muscles cool down. Fatigue also lowers flexibility. After warming up flexibility.

d) Exercise increases flexibility. While doing an exercise, the ability of the muscle to go back to its initial position, after when put to stretch, should not be affected.

e) Strength

Less strength in the antagonist muscle will facilitate movement with large amplitude. In active flexibility, strength of the muscle plays an important role.

f) Age

Flexibility, to a very great extent is age-dependent. Children have more flexibility than adults. Flexibility decreases as the age increases.

g) Sex

Women normally have more flexibility as compared to men. This is due to difference in the joint structure and also due to lower muscle mass in the case of women. Greater muscle mass leads to muscle boundness and thus reduces mobility of joint.

h) Time of the Day

As the day passes, with the increase of environment temperature, the flexibility increases. Extensibility of muscles and mobility of joints get restricted in the winter season. When it is very cold, sportsperson need to warm up for longer duration.

Forms of Flexibility

Flexibility can be classified into two types.

1. Passive Flexibility

It is the ability to perform movement with greater range with external help e.g., doing stretching movement with the help of a partner. This flexibility is generally dependent on the anatomy of the joint and extensibility of the muscles and ligaments.

2. Active Flexibility

It is the ability to perform movement with greater range without external help i.e., with the help of muscular force e.g., performance of a stretching or mobility movement by the sportsperson himself with the help of muscular force. Active flexibility is always less than passive flexibility.

Active flexibility is divided into two types:

i) Static flexibility
ii) Dynamic flexibility

Static Flexibility

Ability to perform movements with large amplitude from a stationary position i.e. standing, sitting and lying e.g. arm circling from standing position, forward trunk bending from long sitting position.

Dynamic Flexibility

Ability to perform movements with large amplitude when the body is in motion e.g. running, jumping, kicking, hitting etc.

Besides above forms of flexibility, some other terms are also used e.g., general flexibility and special flexibility. The term general flexibility describes flexibility of all joints of the body whereas special

flexibility denotes ability to perform specific movements of a game or a sport with greater range.

Methods of Flexibility Training

Flexibility develops quickly when the correct training methods are adopted. It is important to differentiate between stretching as a warm-up activity, and stretching to achieve a long-term enhancement in the range of movement about a joint. Most of the easy stretching done prior to the training session or competition to familiarize muscles with impending exercise is insufficient to bring about longer lasting flexibility benefits. Separate flexibility training sessions shall be performed in order to bring about greater improvements in the range of movement, and working through systematic exercise routines.

Prior to starting with the flexibility training it may be necessary to adhere to the following guidelines:

1. Stretching exercises should be performed after thorough warm up to avoid injuries.
2. Start with an easy stretching programme, working all of the joints form the neck down, and finishing with seated exercises or those performed lying down.
3. Maintain a good posture while performing flexibility exercises.
4. Perform advanced stretching movements towards the end of the session.
5. Work for individual potential and do not try to cheat.
6. When working on partner exercises make sure that the partner understands the exercise as well as its importance and does not stretch the joint too far.

7. Avoid jerky movements in the static stretching exercises; hold the stretch at the limit.
8. All stretching exercises shall be performed slowly and stretching beyond the pain barrier must be avoided.
9. The selection of flexibility exercises should be based on the demands of the sportsperson.
10. The exercise selected should guarantee universal increase of the motion amplitude of the sportsperson.
11. Development of flexibility should be done gradually and systematically. The muscles and ligaments should be gradually stretched performing several repetitions and also gradually increasing the speed and range of movement. Sudden increase in speed may result in pulled or ruptured muscles.
12. The training sets of flexibility exercises are to be so arranged that maximum limit of amplitude of movement is reached several times and is also reached gradually.
13. Training frequency for flexibility development should be high. Flexibility can be developed quickly if there are one or two training sessions per day.
14. After having attained optimum flexibility, if a person discontinues performing stretching exercises, flexibility reduces gradually. Flexibility decreases with increase in age.

The following training means can be used:

i) Ballistic Method

Movement is done with a swing in a rhythmic manner to its maximum range. Good warming up is an important pre-requisite failing, which injuries can result. This procedure has certain shortcomings i.e.

swing movement results in stretch reflex of the antagonist muscle thus creating a hindrance in performing movement over greater range. Inspite of this limitation, the method is still in use because it is more closely related to nature of sports movement and helps in the development of skill. In this method, since agonist muscle performs the movement and the antagonist helping in returning the moved joint to the starting position, it helps in improving neuro-muscular co-ordination.

ii) Slow Stretching Method

This method is better than ballistic method because it results in better improvement of flexibility and also minimizes changes of injury. In this procedure, the muscle is stretched slowly to its maximum limit and then slowly brought back to its original position. Because of slow and gradual stretching, the stretch reflex action is avoided.

iii) Slow Stretching and Holding Method

This method is superior to the previous two training means. In this method, the muscle is stretched slowly to its maximum limit and is held there for about 6 to 10 seconds. The muscle is then slowly brought back to its normal position. In view of slow stretching, this method prevents stretch reflex and minimizes chances of injuries.

iv) Post-Isometric Stretch (PNF Method)

This method of flexibility development is based on the principle of Proprioceptive Neuromuscular Facilitation (PNF). In this procedure, the muscle is first contracted maximally for 6-8 seconds using isometric method. After this the muscle is gradually stretched to its maximum limit. The final position is held for about 8 to 10 seconds. For best effects, the exercise is repeated

4 to 8 times. The research has shown that after maximum isometric contraction, a muscle relaxes better when its tension is overcome. A muscle, which is in a state of perfect relaxation, stretches better to its optimum limit. This method produces best results among all the procedures of flexibility development.

When should a sportsperson perform flexibility exercises?

For optimum flexibility exercise should be perform at the following times.

1. Before practice and competition

Flexibility exercises must form an essential part of specific warm-up routine carried out before a training session as well as before competition. Stretching exercises improve the range of motion by increasing the elasticity of muscles and tendons and functional abilities, which helps in reducing the likely hood of injuries particularly the muscle strains.

2. Following practice and competition

With in five to ten minutes of the cessation of training session and competition flexibility exercises must be performed as a part of limbering down (cool down) process. The increase temperature of the muscles soon after training and competition helps in increasing the range of motion. The increased body temperature helps in improving the elastic properties of collagen present in muscles and tendons, which further improves their strecheability. Stretching exercises performed after training and competition also helps in reducing muscle soreness.

3. Complete training session devoted to flexibility exercises.

Within a micro cycle, a session of training may completely be devoted to flexibility exercises so as to guarantee enhancement of flexibility in the muscles and tendons as per the requirement of the sport. This practice is followed because the stretching exercise done before and after training and competition are not enough to enhance flexibility of the sportspersons. A session of a good warming up shall precede flexibility exercise programme.

A Sample Flexibility Programme

Chapter 3.5

CO-ORDINATIVE ABILITIES

Co-ordinative abilities are relatively stabilized and generalized patterns of motor control and regulation processes that enable a sportspersons to do a group of movements with better quality and effect (Singh, 1991). Co-ordinative abilities have a direct relevance to sports performance. Performance in different games and sports, to a great extent, depends upon the level of co-ordinative abilities of a sportsperson. Co-ordinative abilities depend upon the mechanism involved in control and regulation of movement, the co-ordinative process of central nervous system and functional capacity of various sense organs. Earlier agility was being recognized as a factor representing co-ordinative abilities. Since about two decades back the concept of agility has been replaced by the term "co-ordinative abilities" because of the following reasons:

1. The concept of agility was confusing because various authors defined the term differently.
2. Different authors associated different co-ordinative abilities with agility.
3. In view of different explanations provided regarding the concept of agility, it was difficult to plan a systematized process for its development.

Blume (1978), a sports scientist from the erstwhile German Democratic Republic, as a result of extensive study and research suggested that the concept of agility can be replaced by the concept of co-ordinative abilities and provided a list of co-ordinative abilities which affect performance in games and sports. Over the years

the above concept has generally been accepted. However, there is a need for further research to ascertain various co-ordinative abilities affecting performance in different games and sports. This will help in working out a systematized training process and identify appropriate means and methods for the enhancement of co-ordinative abilities.

Importance of Co-ordinative Abilities

Co-ordinative abilities help in performing movements of various degrees of difficulty very quickly and with efficiency and accuracy. It is presumed that a sportspersons with good level of coordinative abilities is not only able to acquire mastery of the skills with in a short period but is also able to perform the skills well. They are also able to solve training tasks quickly. The following points describe the importance of co-ordinative abilities:

1. The pace of learning and acquiring skills in games and sports is influenced by the co-ordinative abilities.
2. In the long term of training process, the level of co-ordinative abilities of the sportsperson affects the continuous refinement and modification of skills.
3. Co-ordinative abilities benefit the sportsperson by not only learning different forms of exercises needed for training and competition but also those required for recreation and recovery in the training process.
4. Co-ordinative abilities are helpful for economic utilization of motor abilities and acquiring of technical and tactical mastery.

5. Systematized and optimum development of co-ordinative abilities during childhood can help a sportsperson in learning complex skills in later years.
6. In as much as co-ordinative abilities have direct relevance to performance in games and sports, they can form an essential component in the process of identification of potential sportspersons (talent identification).

Characteristics of Co-ordinative Abilities

Characteristics of any area of study also describe its nature. The characteristics of co-ordinative abilities are:

1. The phenomenon of control of movement and its regulation forms the basis of co-ordinative abilities. In view of this the co-ordinative abilities have a direct linkage with the technical aspect of sports performance.
2. The performance efficiency of the central nervous system and the functional capacity of various sense organs are important factors for the existence and further development of co-ordinative abilities.
3. Co-ordinative abilities influence performance in games and sports in combination with each other and also in relation to motor abilities and psychological factors.
4. Co-ordinative abilities improve only when movements are performed. The extent of acquiring mastery will depend upon the quality of movement.
5. Co-ordinative abilities are pre-requisites for acquiring mastery of movement belonging to specific activities e.g. balance ability is essential for learning balance activities.

6. Co-ordinative abilities have general as well as specific application in games and sports. Balance is needed in all games and sports but balance has specific application in gymnastics, shooting and archery.
7. Performance in games and sports is affected by different co-ordinative abilities appearing in varied combinations.

Various Co-ordinative Abilities

Blume has suggested the following seven co-ordinative abilities, which affect performance in games and sports. The relative importance of these co-ordinative abilities varies from sport to sport.

1. Combinatory Ability

It is the ability of a sportsperson to systematically and meaningfully combine the movements of different body parts for successful performance of a sports movement. It also reflects the ability of an individual to effectively combine meaningful parts of a skill into a whole during the skill learning process. This ability has special relevance to combative sports, gymnastics and team games. This ability depends upon the functional capacity of kinesthetic and optic sense organs.

2. Differentiation Ability

This ability enables a sportsperson to achieve high degree of perfection and economy of separate body movements and movement phases in a motor action. This ability is stressed when purpose is to acquire mastery of the skill for effective application during competition. This ability depends upon the functional capacity of kinesthetic sense organs.

3. Orientation Ability

It is the ability of a sportsperson to analyze and change the position of the body and its parts in time and space in relation to performance area (e.g. play field, gymnastic apparatus, boxing ring etc.) or a moving object (e.g. ball, opponent, partner). This ability depends upon the functional capacity of optic sense organ, vestibular apparatus and kinesthetic receptors.

4. Reaction Ability
It is the ability of a sportsperson to respond quickly to a given stimulus and execute well-directed actions following a signal. It depends upon the functional capacity of optic, acoustic and tactile sense organs.

5. Balance Ability
It is the ability of a sportsperson to maintain equilibrium of the body both in static and dynamic conditions. All types of body movements are affected by this ability but it has a special importance when movements are done in a small area. This ability depends upon the functional capacity of vestibular apparatus.

6. Rhythm Ability
It is the ability of the sportsperson to understand the rhythm of movement and to execute the movement with required rhythm. It depends upon the functional capacity of optic, acoustic and kinesthetic sense organs.

7. Adaptation Ability
It is the ability of a sportsperson to bring about an effective change in the movement according to anticipated changes in situation. It depends upon the functional capacity of optic and acoustic sense organs.

In sports, sportspersons perform a variety of exercises (general, special and competitive). These exercises

facilitate development of varied co-ordinative abilities. The exercises should be correctly executed with conscious control of movement. In addition specialized means for enhancing the functional capacity of various sense organs should be adapted. The degree of difficulty of different training means should gradually be increase with the help of different methodical means. It is suggested that for quicker development, exercises should be suitably modified so as to ensure development of a single co-ordinative ability at a time.

Improvement of Co-ordinative Abilities

The co-ordinative abilities needed for skills such as running, jumping and throwing can be developed from a very young age. The rate of acquiring coordinative abilities is exceptional for girls between 8 to 11 years and for boys between 8 to 13 years. The co-ordinative abilities developed at younger age help in learning sport specific skills at a later age.

A clear-cut and scientific methodology for the improvement of co-ordinative abilities is not available at present. The following guidelines are suggested for the training of co-ordinative abilities.

1. The chief method is systematized and guided practice and the principle means physical exercise.
For effective development of co-ordinative abilities, a variety of physical exercises are to be practiced. To ensure proper development, the movements, which have been learnt well, should only be practiced. Movements, which are yet to be learnt, cannot be used for the training of co-ordinative developments.

2. Exercise to be used, as training means should be correctly executed with conscious control of movement.

Repetitions of incorrect movements lead to acquisition of faulty actions, which impede formation of skills. While teaching exercises, a variety of audio-visual aids should be used and after every execution, the performer should receive feedback regarding the quality of movement.

3. Both general as well as special exercises should be performed. Co-ordinative abilities have both general as well as specific application. To begin with, execute general exercises for development of general co-ordination and later switch over to special exercises so as to develop those co-ordinative abilities, which have application to a specific sport.

4. Adopt specialized means for enhancing the functional capacity of the organs.

Increased functional capacity of various senses e.g. sense of hearing, sense of sight, sense of touch, kinesthetic sense and sense of balance helps in improving co-ordinative abilities. The following selected exercises can be performed in this regard.

a) Differentiating body positions and position of various parts of the body.
b) Use of turn-table for improving capacity of vestibular function.
c) Discriminating weights and joint angles.
d) Differentiating between time intervals and rhythms.
e) Noticing a change without directly looking for5 enhancing peripheral vision.

5. Adopting different methodical means, the degree of difficulty of training means should be gradually increased.

Exercises can be made difficult in the following ways:

a) Execute movements with variations.

b) Changing external conditions.
c) Combining movements to make exercise more difficult.
d) Exercise under pressure of time.
e) Variation in information uptake.
f) Practice under conditions of fatigue.

6. The training means selected should be such that they ensure development of a specific co-ordinative ability.

Physical exercises focus attention on development of several co-ordinative abilities. It is suggested that for faster development, exercise should be suitably modified so as to ensure development of a single co-ordinative ability at a time.

Chapter 4

TECHNICAL TRAINING

A technique is a scientific and economical method to attain high sports performance. It is a method developed and improved in practice for the best possible solution of a definite sports skill. Technique is a theoretical model according to which the movements are done. This model is over 100% concrete and has always scope for minor individual adjustments. In games and sports, the technique is virtually the substance and complete control of sports technique is the basic pre-supposition for the achievement of peak performance. All other qualities (motor qualities, psychic qualities etc.) are not very useful to a sportsperson unless he knows how to move functionally. Only a well-trained sportsperson is able to combine a perfectly mastered technique with optimum strength, speed endurance, flexibility etc. The technique changes with time, practice and new knowledge. Technical training means conscious improvement and strengthening of skills of sports with the aim of attaining highest proficiency in competition. Therefore, adequate time shall be devoted to technical training in the total training process of a sportsperson.

There is a close relationship between technique and skill. However, they do not mean the same thing. The skill is acquired through learning and correct practice. Skill is the ability to execute movement or movements of different games and sports in a way that the movements take place automatically without a fault. Skills are acquired through correct practice. A person is not born with the ability to perform skills of sports but

skills are to be learnt through training. In view of differences among sportspersons in the level of motor abilities, structural variations and psychological characteristics, each sportsperson will realize the skill in a different way as compared to the other. This difference in the execution of movement or expression to technique by a sportsperson is termed as style.

Phases of Skill Acquisition

The process of learning and perfecting skills of sports is a time consuming process and the time of learning and perfecting skills varies from sportsperson to sportsperson. The duration of skill acquisition also depends upon the complexity of the skill and pedagogical efficiency of the coach. In the process of skill acquisition a sportsperson passes through three phases namely the phase of attaining rough coordination, the phase of attaining fine coordination and the phase of attaining mastery of skill. The duration of each phase is different and is affected by the nature of skill.

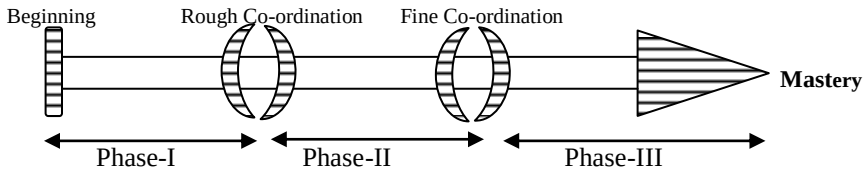


Fig. Phases of Skill Acquisition

Skill Acquisition Phase I

The aim of this phase is to enable the sportsperson to acquire rough coordination. This phase commence with the introduction of the skill to the sportsperson and ends when the sportsperson becomes

capable of performing the skill under easier conditions. In as much as only rough coordination has been acquired, the sportsperson commits several mistakes while executing the skill. Errors take place mainly because the movement concept is not very clear to the sportsperson. The movement lacks proper rhythm and continuity and is invariably jerky. The duration of this phase depends upon the complexity of the skill to be acquired, level of motor components affecting movement execution, motivation, interest and attitude of the sportsperson and instructional capabilities of the coach or the teacher.

Principles of Technique Training During the First Phase

1. Analysis of the present status of the sportsperson
2. Practice under easier and favourable conditions
3. Development of movement concept of the technique to be learnt
4. Lay less stress on kinesthetic perception
5. Avoid too much emphasis on movement correction
6. Less stress on formal competitions

Skill Acquisition Phase II

This phase begins when the rough coordination has been acquired by the sportsperson and ends when the fine coordination has been achieved. Now the sportsperson is able to perform the skill under normal conditions without major mistakes. When the learning conditions change or become difficult or when sportsperson participates in the competition, the errors in the execution of skill again creep in. There is continuity in the process of acquiring fine coordination but sometimes in between there are phase when stagnation of performance is noticed (plateau). It is even

observed that during this phase of learning plateaus the performance deteriorates inspite of continuity in technical training. These phases sometimes have an adverse psychological effect on the sportsperson and thus they need constant encouragement and motivation to continue training. As per the principle of learning curve, this stagnation of performance is temporary and with the continuation of skill learning process, the performance again starts improving. With the development of fine coordination, the rhythm of movement becomes similar to that of the technique model and in view of this there is an economical and effective application of motor abilities. The ability of the sportsperson to combine movements of different parts of the body improves and thus jerky movements are no longer seen.

The duration of this phase depends upon the complexity of the skill, level of motor abilities, skill learning efficiency of the sportsperson, psychic abilities of the sportsperson and teaching staff and capabilities of the coach.

Principles of Technique Training During the Second Phase

1. Since this phase is characterized by stagnation of performance, more help and encouragement should be provided
2. Emphasize high volume of technique training
3. High concentration and attention
4. Practice under normal conditions
5. Improvement of movement concept
6. Emphasis on kinesthetic perception
7. Stress on movement correction
8. Emphasis on competition should be slightly increased

Skill Acquisition Phase III

This phase begins with the attainment of fine coordination by the sportsperson and emphasizes on acquiring the mastery of skill. The skill mastery is realized only when the sportsperson is able to execute the skill effectively during competition and also under different changing conditions. With the acquisition of skill mastery, the sportsperson adjust quickly to changed conditions and executes the skill correctly.

This phase never ends because complete mastery of the skill is difficult to achieve. A highly trained sportsperson is able to achieve only about 85% perfection in execution of the technical model and there is always a scope for improvement of skill performance.

This phase is also characterized by deterioration in the skill due to several factors namely change in the technique model, periodisation, introduction of new elements (gymnastics), sudden change in the measurements of body segments, mistake in load dynamic process and sudden improvement in strength and speed abilities.

During this phase the skill becomes automatic and a high degree of accuracy and precision is observed. The movement rhythm gets perfected and is stable. In view of these, the sportsperson achieves desired results during competition.

Principles of Technique Training During the Third Phase

1. Practice the technique under difficult and changing conditions
2. Further development of movement concept

3. For achieving mastery of the skill emphasize accurate and precise feedback
4. Increased use of competitions
5. Encourage mental practice for stabilization of temporal and spatial aspects of movement execution

Methodical Hints for Technique Training

The following suggestions are given for imparting technique training to sportsperson.

1. Perfection of technique under easy and stable conditions.

In view of easy and stable conditions, skills are learnt faster. The coach should ensure that the load of training approximates the technical level of the4 sportsperson.

2. Consolidating technique under gradual increase of speed and brought in line with the standard competitive situation.

3. Consolidating technique under changing outer conditions.

The external conditions such as weight of equipment, apparatus playing surface, wind condition, elasticity of ball etc. are changed and emphasis is laid on technique learning.

4. Consolidating technique under increased degree of difficulty.

Sportsperson works under conditions which are harder and difficult than the competition. This will enable the sportsperson to keep up functional and

economical movement even under physical and mental strain.

Relearning

In the process of sports training sometimes it becomes essential to change the movement structure of a skill which has already been mastered. Restructuring an already learnt technique may become essential in view of change in the technique modern, change in the structural measurements due to growth, an error picked up by the sportsperson in the initial skill learning process, development of new equipment or implement, change of playing surface and change in the rules and regulations. Due to these the sportsperson has to go through a process of relearning the technique.

In the relearning process, competition between the old and the new pattern can be seen as a four phased development.

Phase I: The old pattern still predominates and takes effect as soon as the sportsperson does not concentrate on the new element.

Phase II: The old pattern is shaken. The new pattern is still not stabilized and due to this performance fluctuates. The old skill frequently interferes with the performance of new patter.

Phase III: The new pattern of movement is gradually acquired but it is not stable. This phase is characterized by gradual increase of performance efficiency. Number of faults also reduce.

Phase IV: This phase completes the process of acquiring new movement pattern and performance becomes stable. Execution of new skill becomes automatic and

the sportsperson does not have to concentrate on the skill.

Methods of Technique Training

In the process of technique training several methods are used and the choice of a method depends mainly on the age and the learning efficiency of the sportsperson. The coach or the physical education teacher should arrange the teaching stages in a proper sequence so that learning can be guaranteed. The following three methods of technique training are used:

1. Presentation Method

This method is teacher dominating and the sportsperson is in a state of mental readiness to learn the technique.

In sports training the presentation method is used in two forms:

a) Demonstrating: The skill is demonstrated by the teacher. To enable the student to have a complete mental picture the skill may even be broken up into meaningful components and each component may be separately demonstrated. Later all the components are combined together. Student is provided an opportunity to practice under the supervision of the teacher. On the spot corrections are done. For better results, help of films, photographs and video is also taken.

b) Explanation: Explanation generally precedes demonstration or even combined along with demonstration method. In the initial stages the explanation should be short and simple. It should also be used to motivate and encourage the student. Explanation can also be used while showing films, video and photographs. The language used for explanation

should be simple and must correspond with the level of understanding of the student. Explanation method is more effective for matured students.

2. Co-operative Method:

In this method of technique training, both the teacher and the taught are active and cooperation between the two ensures better learning. The student practices the skill under the supervision of the teacher who corrects him and guides his practices. Another variation of cooperative method is the discussion between the teacher and the student. The teacher also encourages and motivates the student.

3. Task Method:

In this method the studnet is more active and functions independently with very little help from the teacher. The teacher assigns a certain task to the student which is to be carried out alone by him. This method develops self reliance, discipline, responsibility, self control and self confidence on the part of the student and thus has very high educational value. The following tasks can be assigned to the student:

a) Observation task
b) Movement task
c) Performance task
d) Practice task
e) Study task
f) Assessment task

Cause of Faults and Their Correction

During the process of learning skills of games and sports, it is essential for the teacher/coach to be observant, identify the errors, find out the cause of error and emphasize immediate correction. A good teacher/coach is one who can identify the mistakes and suggest ways and means to correct. In order to provide

proper help to a sportsperson it is essential to know the cause of fault. He should eliminate the cause of fault in order to ensure correction.

The following are the causes of errors:

1. Inadequate development of motor abilities
2. Fear, anxiety and nervousness
3. Illness and fatigue
4. Lack of motivation
5. Interference by an already learnt skill
6. Inability to understand movement
7. Inadequacy of sports equipment.

Correction of Errors

1. Comparison between right and wrong movement

This can be done with the help of photographs, video films and other visual aids.

2. On the spot correction

Emphasize correction on the spot. Practice of faulty movement develops into a faulty habitual motor pattern.

3. Exaggerated demands

In case old and new movements cannot be differentiated, it is advisable to exaggerate required correction.

4. Practice of the movement in its meaningful parts

Complicated skills are divided into meaningful components and correct practice of each component is emphasized. In the end the components are combined into a whole.

5. Adopting ways and means to removes fear and anxiety.
6. Arranging the movement task in a proper sequence i.e. simple to complex so as to minimize errors.

Chapter 5

Tactical Training

It is difficult to say where ends technique and where begins tactics. There is a very clo9se relationship between the two. Tactical training should be started only when the skills of a intelligently and creatively apply skills during the competition. The extent of tactical mastery and its application by a sportsperson during competition has become a significant factor in deciding victory and defeat.

The term tactics and strategy are used interchangeably and synonymously in games and sports but in true sense their real meaning is different. Strategy is the overall plan of a sportsperson to successfully participate in competition whereas tactics is the actual realization of strategy in practice. The word strategy also means putting the tactics into use as a tem effort.

Basic Tactical Conceptions

The basic purpose of using tactical actions during competition is to win or to put up high sports performance. Depending upon the prevailing circumstances during the competition, the sportsperson or the team resorts to application of different tactical concepts, which are explained as under:

1) In this tactical pattern the opponent is forced to accept his own plan of competition. The sportsperson or the team on attack takes initiative and creates such circumstance that will allow the opponent to be beaten in a favourable situation. An offensive basic position could also be to allow the opponent to attack and then

counter very quickly without giving an opportunity to the opponent to adjust to the new situation. Application of offensive tactics during competition is more advantageous in comparison to other basis tactical conceptions and therefore during training adequate time should be devoted for acquiring their complete mastery.

2) Defensive Tactics

In this tactical pattern the sportsperson or the team limits entirely to defense and leaves the initiative of controlling the contest to the opponent, waiting passively for the opponent to make mistake and then use this occasion for a counteraction, which would decide the contest in his favour.

3) High Performance Tactics (Record Tactics)

The purpose of this tactics is to create a record or to establish peak performance during the competition. The essence of this tactical pattern is to keep up intensities, which are as high and as steady as possible. To apply this tactical conception effectively and successfully in the competition, the sportsperson has to be in a state of optimal physical and psychological preparation.

The above tactical conceptions are applicable in all games and sports; however, in individual sports their use is limited. To excel in the competition, in addition to complete physical, technical and psychological preparation, the sportsperson or team has to learn and master various tactical patterns. Therefore during training adequate time shall be spent on this important aspect in order to achieve optimum performance during competition.

Methods of Tactical Training

1) Acquisition of tactical knowledge is of great importance for comprehensive tactical mastery. The principles of tactical behaviour must become a part of all competitive actions of the sportsperson. The theoretical knowledge helps a sportsperson to orient him in complicated contest situations, to analyze them, to assess the possible method of their solution and to select the most effective method of solution in order to apply it successfully during competition. The theoretical knowledge imparted to sportsperson should be the one, which has been tested and utilized during competition and found effective and successful.

The following four stages are recommended for imparting tactical knowledge to sportsperson.

Stage I-Explanation of rules and regulations of the game. Ignorance of rules and regulations of a sport invariably prevents application of various tactical actions during competitions. Infact the sportspersons or the team should know the extent to which the rules can be exploited and utilized for effective application of tactics.

Stage II-Description of the playing system whereby the position in the game, the functions of the players etc. are clearly and in detail indicated.

Stage III-Detailed analysis of the phases of play. this analysis should be combined with a critical review of tactical errors made by the sportsperson during competition. The tactical deficiencies and advantages which come up in matches should be analyzed with the help of photographs, films etc.

Stage IV-Theoretical solution of tactical exercises of different degrees of difficulty.

2. Consolidation of Special Tactical Knowledge

Perfect grasp of individual and collective tactical actions is the basis of any tactical mastery in sports. The tactical actions to be taught to the sportsperson are explained and demonstrated. The sportsperson must get a conception, which is as complete as possible, about the possible variations as well as about the level of tactical efficiency of the opponent. All variations of tactical actions should be explained and practiced so that the sportsperson can understand and learn the situations under which they are applicable. For consolidating tactical knowledge the following methodical steps are used:

a) Practicing the tactical action under simplified conditions of training:

As a part of training, various tactical patterns are to be learnt by the sportsperson. The training conditions should be so arranged that the sportsperson gets a clear concept about each tactical concept. On the spot corrections should be made.

b) Practicing of diverse variations of the same tactical action:

The sportsperson should also have an opportunity to practice variations of different tactical patterns of attack and defense and master them so that depending upon competition circumstances; the most appropriate variation can be adopted.

c) Selection of the most appropriate variation of tactical action while solving a set tactical task in a training contest (build-up competition):

The tactical skills should be mastered under competitive conditions in combination with other elements of performance. Emphasis should be laid on applying variations of tactical skills under constantly changing conditions of competition. The degree of difficulty of the competition should be gradually increased e.g. with passive opponent, with active opponent and also with more than one opponent. Competitions under varying and difficult conditions and against opponents of different performance levels are a necessary pre-requisite for mastery of tactical skills. During build-up competition an opportunity should also be provided to the sportsperson to create situations and circumstances for applying their best skill by purposefully controlling the course of competition.

3. Development of Creative Abilities

Creative abilities enable a sportsperson to gain quick orientation in competition, to assess arising situations correctly and quickly and to react accordingly. Creative abilities also help a sportsperson to apply his physical, psychological, technical and tactical aspects according to the circumstances arising during the competition and tackle such situations effectively. The following creative abilities are important and, therefore, should be developed.

i) Orientation Ability: Adjusting and getting familiar to the play area and space around it as quickly as possible. This ability also helps to change the movements and position of the body in time and space in relation to a definite field of action. This ability can be developed by improving the functional efficiency of kinesthetic and optic sense organs.

ii) Differentiation Ability: To achieve high degree of precision and economy of separate body movements

and movement phases while executing a sports movement. This ability can be developed by improving the functional capacity of the kinethetic sense organs.

iii) Intellectual Ability: This ability enables a sportsperson to anticipate the arising situations during competition and to think and decide as quickly as possible.

This ability can be improved by exposing the sportsperson to a variety of new situations during training and competition.

iv) Emotional Ability: Ability to control one's temperament and anger. To develop this ability, the sportsperson has to be constantly told to control emotions failing which attention, concentration and decision making ability will decline.

Control and Evaluation of Tactical Knowledge

Use of control measures (testing procedures) to evaluate tactical knowledge is essential in order to assess the effectiveness of the training programme. Based on the feedback received by the coach necessary modifications are made in the means and methods of training in order to improve their effectiveness. The theoretical knowledge acquired by the sportsperson is checked orally and also in writing. The tactical skills and creative abilities can be assessed in competition adopting the following procedures:

a) Observation i.e. observations recorded in writing, observations expressed in graphs and observations recorded in the form of film.
b) Measuring performance in terms of time, distance, height etc.
c) Administration of tests.
d) Performance trials.

Chapter 6

PLANNING OF SPORTS TRAINING PROGRAMME

Basic Concept of Planning

Planning is an objective necessity under the conditions of our social order. In the area of national economy, planning is a means of securing constant growth and improvement of production and attainment of self-sufficiency in different facets associated with the progress of a nation. These plans cover a lengthy period and comprise, besides aim of production, all the factors e.g. finance, manpower, material, means etc., which affect the attainment of goals. All this, in principle, also applies to planning of sports training. After having determined the goals, the coaches and sportspersons have to develop training plans of longer and shorter duration for ensuring the attainment of immediate, intermediate and ultimate objectives. The training plan is a binding directive for improving the training state of a sportsperson where all the required measures (forms of training, nature and frequency of competition, control measures etc.) are recorded in writing.

The need to develop training plans of longer duration arises from the fact that sports performance comparable to national and international standards can be achieved only after several years of uninterrupted training. As the development of training condition after several years of training can only be seen approximately, it is also essential to develop training

plans of shorter duration in which the specific goals and tasks could be laid down taking into consideration the particular level of attainment. In view of the above the long term training plans are described as indirect training instructions and the plans of shorter duration are termed as direct training instructions.

Definition of Training Plan

It is a binding directive for developing training condition where all required measures are recorded in writing.

To plan means:

(a) To lay down the performance aim to be achieved.
(b) To determine tasks arising from the performance aim.
(c) To determine the sequence in which the tasks are to be achieved.
(d) To determine means and methods for the solution of main tasks.
(e) To anticipate development of loading.
(f) To select most suitable form of organization.

Principles of planning

Coaches and physical education teachers have to regard these principles as guiding factors so as to ensure preparation of effective training plans. Various Sports Federations and Associations must also develop their own training plans for the preparation of their teams for participation in important competitions. While developing training plans, the following principles should be kept in mind.

1. Sports training plan must be based on the national philosophy.

The training plan must be based on the social needs and necessary tasks of the society. The aim and tasks of sports training should not be contrary to the interest of the nation.

2. Sports training plan must have a scientific basis.

The sports training plan should correctly mirror the discovered laws of development in the field of methods and theory of sports training. The training plan should take into consideration the latest finding of research so as to keep the plan up to date.

3. Planning must follow the principle of democracy.

Any individual who can significantly contribute for making the sports training plan effective, should have an opportunity to participate in the development of the plan. Even the sportsperson should from part of such a planning group.

4. Sports training plan must be constantly improved.

Preparation of an effective sports training plan is a complex process. All-important factors, which have a direct or indirect effect on performance, should be carefully regarded and properly coordinated.

5. Important points of training plan must be properly fixed and correctly coordinated.

Idea is not to develop a training plan and then sit down waiting for the results to be achieved. In fact planning is a dynamic process, the training

plan has to be controlled, assessed and modified on a regular basis in the light of performance attained by the sportsperson and also based on the latest findings of the researches done in the field of science of sports training.

6. Sports training plan, evaluation and control measures constitute a unit.
   In order for the sports training plan to be effective, it has to be constantly evaluated with the help of various measures of control (tests, performance during competition etc). Correct evaluation and analysis of training condition of a sportsperson must precede development of any sports training plan.

Systems of Planning

Several systems of planning are available and in fact a sportsperson has to follow all the systems so as to ensure attainment of high performance in a specific sport. They are:

1. Long Term Development Plan
2. Olympic Plan
3. Annual Plan
4. Sectional Plans
5. Day's Plan

All the plans form a unified training basis and the plan of several years indicates the main line of development. Content of training is more concrete and specific in a plan of shorter duration. All the sports training plans of shorter duration are worked as per the requirements of plans of longer duration.

While planning a training programme for a sportsperson or a team, the following questions should be ask:

1. What performance goals are to be achieved by the sportsperson or team?
2. What are the exact days of the important competitions? This would facilitate planning of correct peaking.
3. What are the strengths and weaknesses of the sportsperson or team?
4. What a sportsperson or team requires in respect of physiological, psychological, technical and tactical capacities?
5. What are the best methods of training the above capacities?

Long Term Development Plan

It is a largest unit in the system of planned training. The duration of this plan is approximately 8 to 15 years. This plan begins with the basic training of the sportsperson and continues until the attainment of optimum performance standard in a specific sport. This plan lays down the main tasks, the training methods and means and the organization of training over a prolonged period of time. Attainment of aim and tasks of this plan marks achievement of performance comparable to national and international levels and thus is turn leads to improvement of world standard. As the world standard of sports performance improves, this plan also must be modified and improved.

In fact research is needed to find out number of years required for the attainment of every single task, best sequence in which these tasks can be best fulfilled and to identify the most effective training methods and means.

GENERAL FRAMEWORK FOR THE LONG-TERM DEVELOPMENT OF A FOOTBALL PLAYER

Stage	Age	% Football/ Non football	Physical conditioning-development of motor components	Psychological development
Development & Performance	13-15	65-35	• Develop reaction speed of lower and upper extremities. • Emphasize on development on sprinting speed • Develop fine coordination and agility. • Develop flexibility. • Develop strength using own body weight exercises. • Develop speed endurance. • Strength training using medicine balls and light weights. • Participation in complementary sports. (Approx. 8 hours per week)	• Emphasis on lea and performing well than winning. • Emphasis on effort. • Encourage ch to love the competiti • Encourage setting/self-managem • Continue to emp 100% effort.
High performance	16-18	70:30	• Full development of aerobic endurance. • Strength training with weights. • Increase in plyometric (hopping, bounding & depth jumps) training. (Approx. 8 hours per week)	• op self-reliance independence responsibility for training.
High performance & consolidation	Above 18 years	75:25	• Complete development of all important motor components keeping in mind the requirements of the game. • Consolidation of conditional abilities. • Strength training with barbells as well as plyometric exercises.	• Develop self-re i.e. independence responsibility for training.

Olympic Plan

As is evident from the name, the duration of the Olympic Plan is four years. This plan begins after the Olympic Games and prevents the post Olympic year from turning into a holiday year thus preventing loss of sports performance and progress. Olympic Plans are set out as overall plans of the Federation/Association. Over a period of four years, the various Federations develop training programme in order to bring their teams to the optimal performance level at the time of competition.

An Olympic Plan should comprise of the following:

a) Health and metabolic condition of the sportsperson as examined by the sports doctor.
b) Duration, content and load of previous training.
c) Tendency of performance development, performance standard, structure of competition and results.
d) Level of various motor qualities and motor skills.
e) Level of mental qualifications and attitude of the sportsperson towards training and competition.
f) Inclination and interest in sports.
g) Domestic and professional conditions and prospects.

In order to make the Olympic Plan more effective and goal oriented for an individual sportsperson, in addition to the above details, it should also include the following information:

a) Personal data
b) The results of performance analysis
c) The results of personality analysis
d) The goal-final and the intermediate goals for each year and each aspect of training condition.
e) The main training tasks for various years
f) The main competition tasks

g) Indications with regard to sub-division of periods of training.

h) Indications with regard to increase of training load and for load dynamics for the Olympic Games Cycle.

Annual Plan

As is clear from the names itself, it is a plan covering a period of twelve months. This plan is formulated keeping in mind the day and month of the important competition and it does not have to necessarily correspond with the calendar year extending from January to December. After having known the dates of the important competition, one goes back over a period of twelve months and then plans systematically for the attainment of high performance.

The training year in all sports is to be treated as a closed cycle. This results from the fact that all-important competitions are held in a definite season and decisive highlights are set by each of the international competitions and championships (Olympic Games, Asian Games, Commonwealth Games, World Championships etc.). In order to ensure a careful build up of performance and to be in the best form for the decisive competition of the year, it is necessary to work out the yearly plan systematically. The training year is to be treated as a section of the plan for several years.

Unlike the plan of several years, the yearly plan must set a whole series of details pertaining to the selection of training means, the frequency of build-up competitions in which the sportsperson is to participate is also planned. Better the coach understands his sportsperson; more thorough and detailed will be the annual plan. The more detailed the annual plan is, better correlation can be recognized and considered

while fulfilling the training tasks. The yearly plan for an individual sportsperson also comprises of a number of special plans, which apply to the development of physical and motor fitness factors, technical and tactical skills and imparting of theoretical knowledge pertaining to a sport.

An annual plan should include the following:

a) Personal data
b) Results of performance analysis
c) Results of personality analysis
d) The goals of performance
    i) The goals of optimum performance to be attained in competition during the year
    ii) The goals of performance pertaining to different aspects of the training state.
    iii) Setting of dates for (i) and (ii) above.
e) A survey plan of periodisation and distribution of salient training points for important tasks during different periods of training.
f) A survey, which shows overall, load in hours and distribution of hours for the main tasks.
g) A survey plan for the entire structure of loading.
h) A special plan for development of strength:
    i) Means and their uses
    ii) Mean methods of loading
    iii) Development of load
    iv) Control exercises and control dates
i) Educational tasks
j) Competition planning
    i) Distribution of main contests
    ii) Distribution of build-up contests
k) Measures of control and evaluation

It is important to note that the process of planning does not get completed with the formulation of

the annual plan. As a result of training the personality characteristics and sports performance of a sportsperson change thus requiring alternation in the type of exercises and process of loading. The plan is to be constantly evaluated and modified as per the requirements.

ANNUAL TRAINING AND COMPETITION PLAN

Months	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug
Competitions												
Periodization	Gen. Preparation			Sp. Preparation			Competition					Tran.
Mesocycles	Cond.	General		Specific					Unloading		Peak	
Strength	General		Maximum		Explosive		Maintain					
Endurance	Aerobic Capacity		Max. Aer. Power		Ana. Alac. Power		Ana. Alactic Capacity			Maintain		
Speed	Develop running speed				Development movement speed							
Flexibility	Development of flexibility						Maintain					
Technique	Maintain and improve basic skill				Learn variations		Maintain & develop rhythm and coordination					
Tactics			Elementary tact. & acquire adv.		Acquire advanced tac.		Consolidate and apply during competition					
Testing												
% Training time:												
Conditioning	70	60	50	40	30	20	20	20	20	30	20	
Skill	30	40	30	30	40	40	40	40	30	20	20	
Tactics	-	-	20	30	30	40	40	40	60	60	60	
Training Load 100%												
80%												
60%												

Legends:

TRAINING GUIDELINES FOR THE DIFFERENT PHASES OF THE ANNUAL PLAN

1. General preparatory period (4 to 6 weeks)

Objectives	Technical and Tactical Development	Physical Development	Competitions
• 'Training to train.' • Increased amount of training. • Laying solid foundations. • High level of physical conditioning. • Challenging aerobic and strength systems. • High volume and low intensity. • Producing a strong and resilient player. • Understanding of Technical & tactical objectives. • Learning of specific skills/ movements of different skills of football. • Developing	• Drilling for consistency, developing skills of football. • Coach to ensure development of proper technique. • Introducing new skills. • Developing player's effort. • Working primarily on improving weaknesses but also on developing strengths. • Making any necessary adjustments to the event technique.	• Challenging & developing aerobic system: muscular & cardio respiratory endurance. • Heart rates 55% to 85% of maximum heart rate. • 25 to 40 min. continuous long distance exercise 3 to 4 times a week. • Use interval training. • Cross training: cycling. swimming, basketball, soccer, volleyball etc. • High volume but not energy-intensive. • Challenging strength system: light	• Playing down the importance of results. • Decreasing the number of comp. • Using competitions, if any, to develop technical & tactical aspects of the game. • Playing with the long –term development goal in mind.

the player commitment and effort. • Minimizing the importance of results in competitions. • Developing the performance rather than worrying about the result.		weights & frequent repetitions (2-3 sets of 12 to 15 rep.) • Strength programme 30 min. 2-3 times a week.	

2. Specific Preparatory period (4 to 6 weeks)

Objectives	Technical and Tactical Development	Physical Development	Competitions
• T raining to be sharp. • I mprovement & perfection of technical & tactical objectives through training. • F ootball specific physical development; challenge	• Work on technical strengths. • Improve tactical knowledge. • High intensity training workouts. • Specific training of skills. • Train twice a day. First session could be devoted for conditioning and second session for technical practice. • Emphasis on	• Challenge anaerobic system: interval training, sprints, fartlek. • Challenge speed system: sprints, plyometrics. • Challenge power system: low volume, high intensity and explosive power. • Challenge strength system: moderate weights and frequent repetitions (3-4 sets of 8-10 reps) • Work: rest ratios closer to requirements of	• tart to compete in more secondary comp. • ncrease the number of built-up comp.

anaerobic system, develop speed & explosive power. • Low volume & high intensity.	skill perfection. • Sessions can be slightly shorter but with intensity and quality. • Create high intensity competitive situations. • Emphasize work that has already been covered, i.e. work on strengths to build self-confidence.	the game (app. 1:3). • 80% of the time in bouts of less than 20 secs. and 20% of the time in bouts of more than 20 secs. • Rest intervals of 15-30 secs. between sets and 2 min. rest periods interspersed throughout the conditioning session.	

3. Pre-competitions period (a week to a few weeks)

Objectives	Technical and Tactical Development	Physical Development	Competitions
• Fine-tune your competitive skills. • Testing of the player's skill in competitive situations. • Specific recommendations for short-term improvement. • Maintenance of physical improvement; training becomes highly specific, high intensity and low volume. • Taper off as you get closer to meets.	• Feedback to be tactical in nature. • Warm up period for training should be similar to the warm up period for a competition. • Psychological peaking; practice sessions with a psychological emphasis. • Highlight and work on strengths. • Structure session to simulate competition (similar work: rest ratios). • No major changes.	• Heavier weights and less repetitions (4-5 sets at a weight the player can perform 4-8 reps). • Challenge anaerobic training: short sprints and plyometrics. • Decrease aerobic training. • Fine tune specific ability and athletic movements.	• Compete in preparatory competitions. • articipate in built-uo comp.

4. Competitions period (few weeks to several months)

Objectives	Technical and Tactical Development	Physical Development	Competitions
• The main	• Practice the skills to acquire mastery.	• Main tain strength and	• Emphasize feelings

objective is peaking in the important comp. • aintaining the best physical, technical and mental shape. • ombine comp. with days or weeks of rest.	• Adapt types of comp. to player characteristics. • Warm up physically, technically and psychologically properly before each competition. • Follow the pre-comp. routines stabilized for each player. • Stretch and cool down after each competition. • Volume depends on the amount of competitions. • Slight adjustments. • Adapt training according to opponent's performance.	endurance levels. • Decr ease the strength-training programme. • Use circuit training (1-2) sets at 12-15 reps). • Main tain the fitness level. • Intro duce 'road work': including sprints and interval training. • Main tain the level of fitness (1-2 runs of 25-40 mins per week).	of total readiness for the competitive challenge. • De velop practical pre-comp. and post comp. routines. • Fo cus concentration on mastery of techniques. • Us e visual aids • M otivation and discipline.

5. Transition period (1 to 4 weeks)

Objectives	Technical and Tactical Development	Physical Development	Competitions
• The main objective is recovering from the stress of competing. • A stage of active recovery after major competitions. • Psychological and physical rest and recuperation.	• The transition phase is probably the most underrated phase in football training. • Whe	• P articipation in other sports, eg, handball, basketball, hockey, volleyball	• H olidays, going out, family, friends, etc. • T ake some time to

• Assess post meet performance. • Discuss areas that will need attention in the next preparatory phase.	n starting to train again it is possible to work on technical changes.	etc. (cross training) • L ight fitness training.	recover from training.

Sectional Plans

Planning of Macro, Meso and Micro Cycles of Training

Sectional plans are termed as plans of phases, periods and weeks. Different periods of the training year namely preparatory periods, competition periods and transitional periods; various cycles of training i.e. macro cycle, meso cycle and micro cycle are all examples of sectional plans. These plans are prepared in accordance with the recommendations of the annual plan. These plans being shorter in duration, the details regarding training of different components of performance are more specific. The training contents, the process of loading and attainment of tasks can be indicated more specifically and thus assessed more objectively. Different cycles of training are being discussed here and the details regards different periods to training have been discussed under periodisation. The three cycles of training are:

1. Macro Cycle: The duration of this cycle is 3 to 12 months and thus is considered as the longest cycle of training. The purpose of the macro cycle is to enable the sportsperson to improve the performance capacity so as to put up optimal performance, at a specific time, during the competition. A macro cycle comprises of several meso cycles and the last meso cycle ensures recovery and realization for smooth transition to the next macro cycle.

The month periods (mesocycles)

Type	Characteristics
Initial	At the beginning of the preparatory phase. 2 weeks. Low load (high volume and low intensity).
Preparatory	During the preparatory phase. More than 2 weeks. High volume and high intensity. Physical and technical training.
Pre-competition	Polishing during preparation and competition phases. More than 2 weeks. Low volume, high intensity. Skill specific training and training comp..

Competition	During competition phase. No more than 3 weeks a row. Technical, tactical, physical and mental preparation for comp..
Recovery	During specific preparation, competition and transition phases. From several days to several weeks. Low load. Practice of other sports.

The week periods (microcycles)

Type	Characteristics
Preparatory	During the preparatory phase. General preparatory microcycle: 20% athletics, 80% physical training. Specific preparatory microcycle: 35% football, 50% physical training, 15% combined training.
Pre-competition	During the pre-competitive phase. 50% athletics, 30% physical training, 20% training comp. and participation in comp..
Tapering	It involves reducing the amount of training in preparation for competition. Specific skills are practiced similar to the performance occurring in competition are utilized combined with a reduction of the length and frequency of the sessions.
Competition	2 or 3 microcyles in a row maximum. Competitive intensity training sessions with low effort recovery exercise. Approximately 70% training comp. & comp., 15% football training and 15% physical training.
Active rest	When competitions are very close together (i.e. less than two weeks apart) it is better to take three or four days of active rest as an active rest microcyle. Then, the player has to skip the preparation phase and go directly into the pre-competitive phase. Approximately 15% training comp., 40% football training and 45% physical training and practicing other sports.

Day plan (sample)

Day	Content of Training	
	Morning session	Afternoon session
Saturday	Active rest	Warming up –General and special Strength training
Sunday	Warming up –General and special Development of endurance-continuous running (30-40 min.)	Warming up –General and special Specific skills practice

Monday	Active rest	Warming up –General and special Strength training
Tuesday	Warming up –General and special Speed training-60 to 80 m running with maximum intensity Stretching exercises	Warming up –General and special Specific skills practice
Wednesday	Active rest	Warming up –General and special Specific event practice
Thursday	Warming up–General and special Strength training Fun ball skills	Warming up –General and special Training Comp.
Friday	Rest	Rest

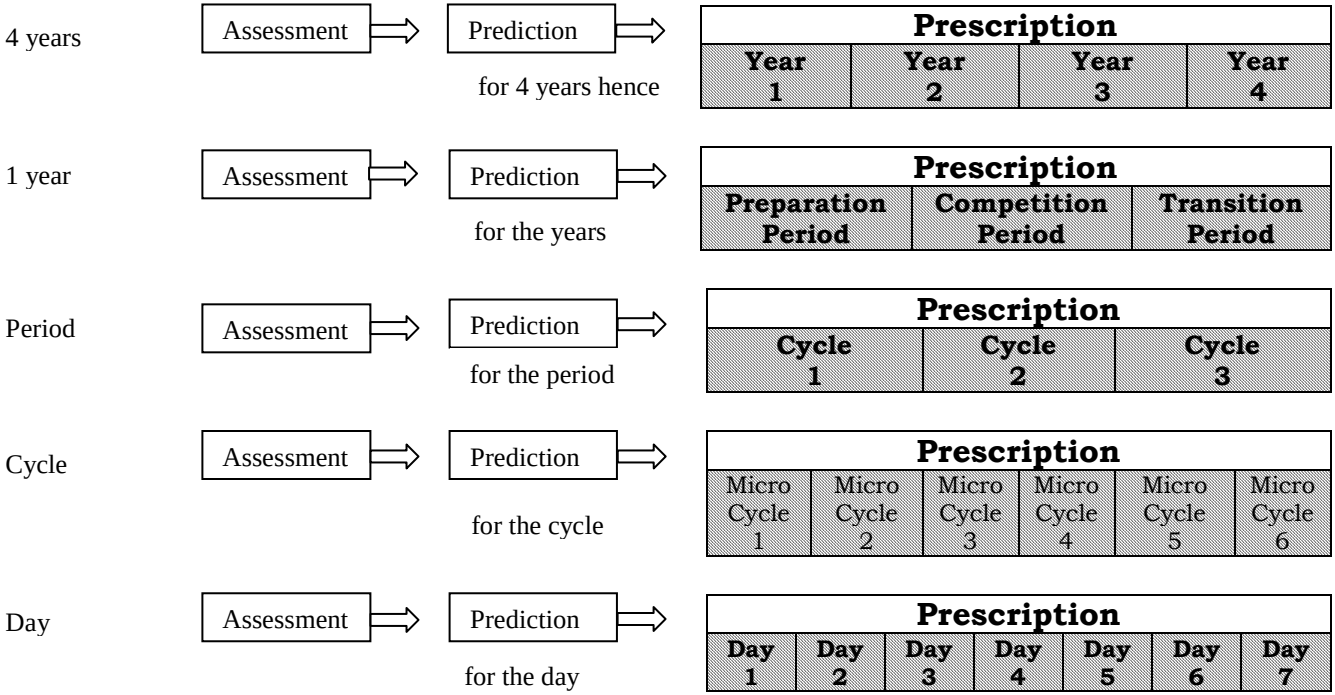
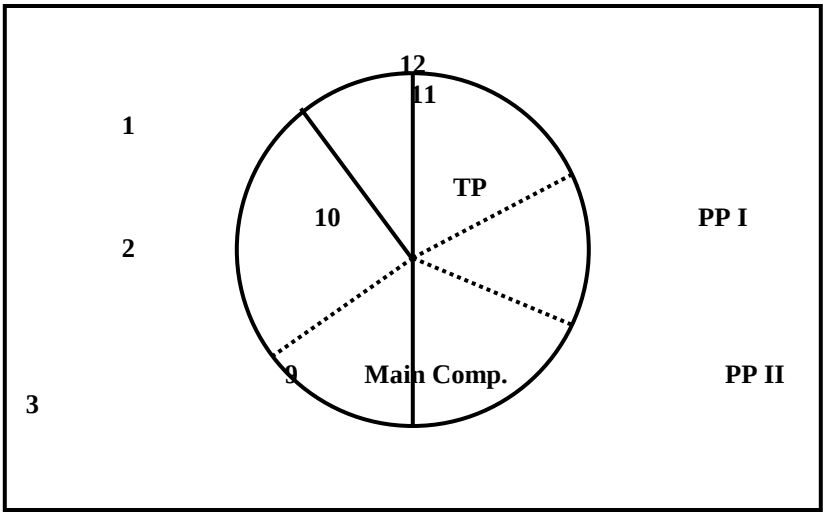


Fig. 2. An Olympic Plan Broken into Smaller Time Units (adapted from Kinsman, 1983)



2. Meso Cycle: The duration of this cycle of training is 3 to 6 weeks and is thus termed as a cycle of medium duration. The purpose of this cycle is to tackle specific training tasks. These tasks are:
   a) Learning and acquiring mastery of skills
   b) Maintenance and stabilization of performance
   c) Development of physical and motor fitness components
   d) Preparation for a specific competition
   e) Attainment of optimal level of performance
   f) Preparation for the next meso cycle by providing recovery and relaxation.

   Meso cycle of 4 weeks is considered to be the best because this is the minimum period within which significant change is affected in the physiological and psychological factors. The last week of the meso cycle of training considered as a transitional phase and thus ensuring recovery and relaxation.

To enable a sportsperson to reach high performance, the load of training fluctuates, in each meso cycle. In the first half of the meso cycle the volume of load is increased and the intensity of load is slightly increased or maintained. In the second half of the cycle the stimulus intensity is increased and the stimulus volume is maintained or decreased.

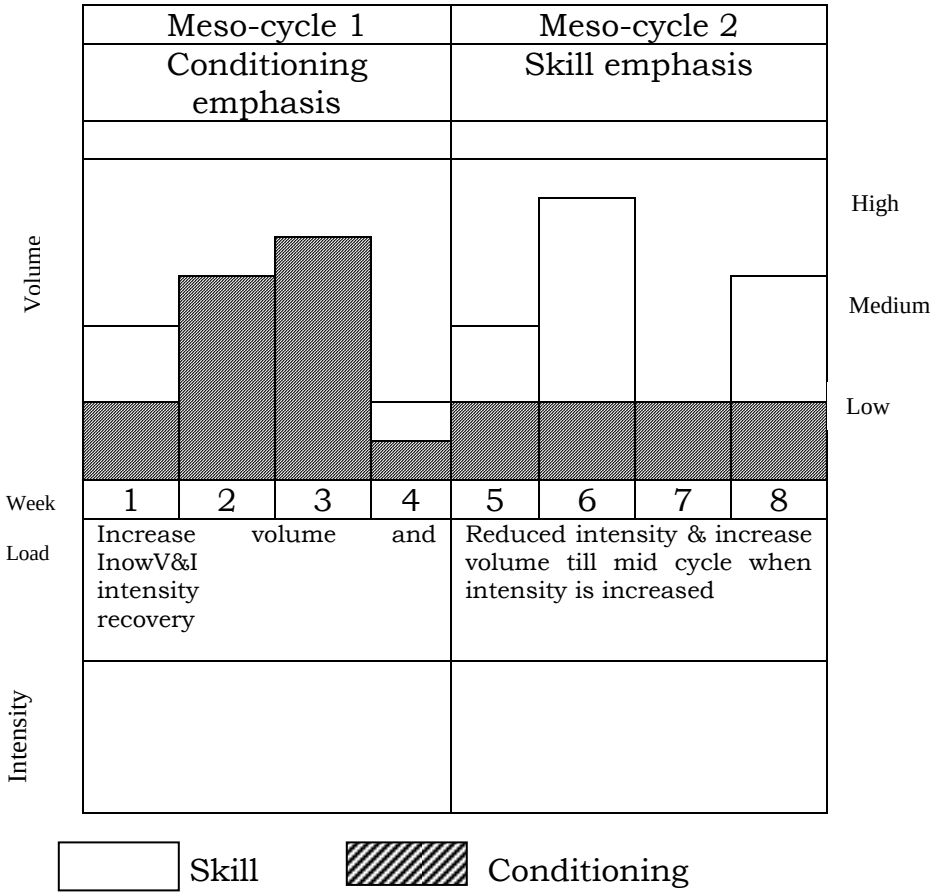


Fig. 7. Two Meso-cycles with Different Emphasis on Conditioning and Skill

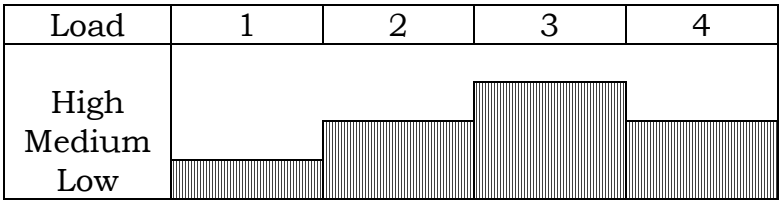


Fig. 5. A Step-by-Step Meso-cycle

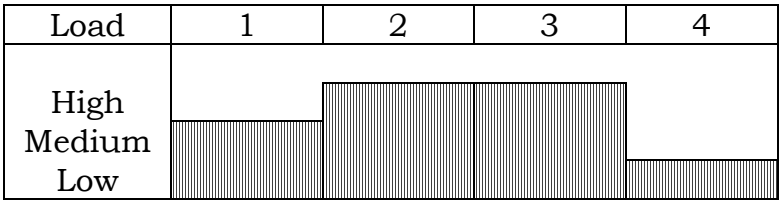
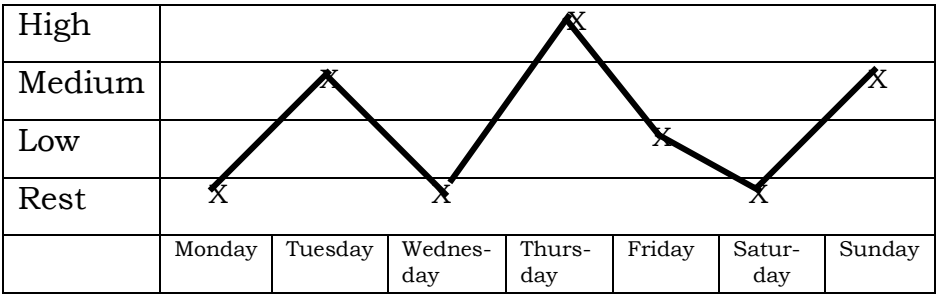


Fig. 6. A Pre Competition Meso-cycle

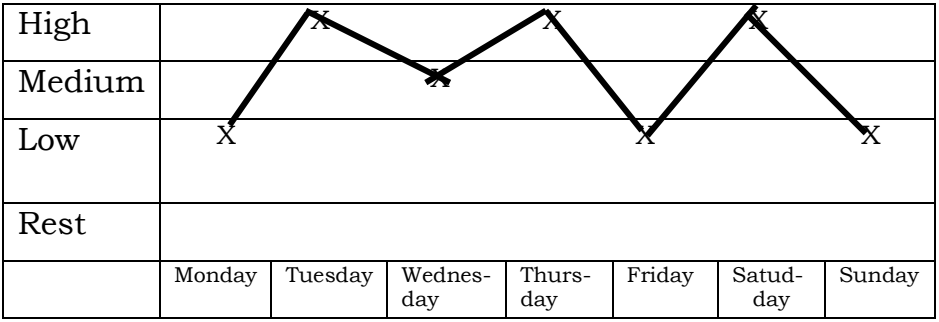
3. Micro Cycle: The duration of this cycle is 3 to 10 days and is thus considered as the shortest cycle of training. In the case of an intermediate and high performance sportspersons, the duration of this cycle is 5 to 10 days. The last day of the micro cycle is used for providing active recovery and relaxation to the sportsperson so as to prepare him for training in the next micro cycle. Even though 5 to 10 days time is not adequate to achieve most of the training tasks yet it forms an important part of the total training process. The following three proportions of high and medium or low load are adopted in the micro cycle.

   a) 1:1 i.e. every one-day of high load is followed by a day of medium load.
   b) 2:1 i.e. every two days of high load are followed by a day of medium load.

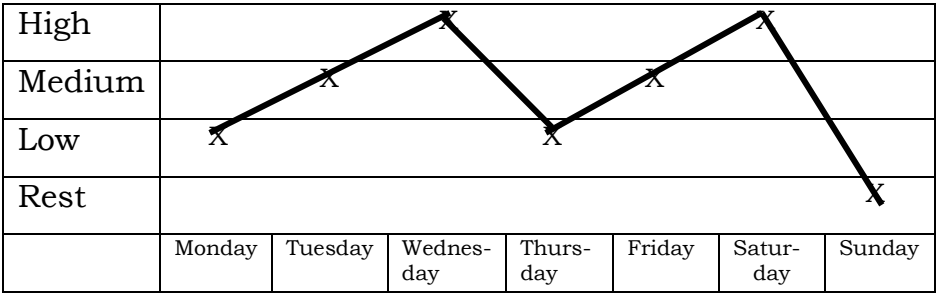
c) 3:1 i.e. every three days of high load are followed by a day of medium or low load.



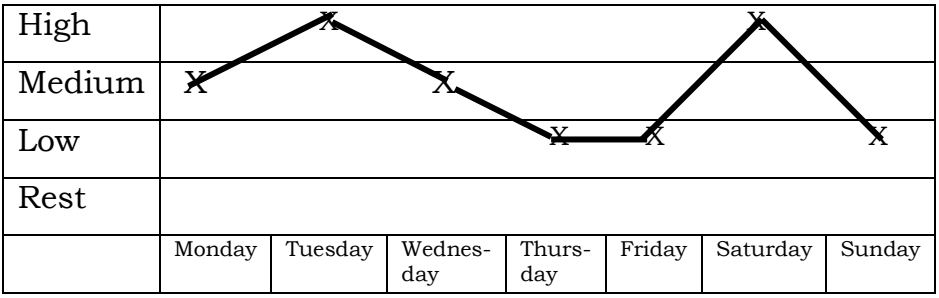
Preparatory Period Micro-cycle for an inexperienced sportsperson



Competition Period Micro-cycle for an inexperienced sportsperson



Preparatory Period Micro-cycle for an experienced sportsperson



Competition Period Micro-cycle for an experienced sportsperson

	Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	**Sunday**
AM	Training		Training		Training		
PM	Training	Training	Training	Training	Training	Training	

Fig. 8. A Nine-Session Micro-cycle

	Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	**Sunday**
AM	Training	Training		Training	Training	Training	
PM	Training	Training	Training	Training	Training	Training	

Fig. 9. An Eleven-Session Micro-cycle

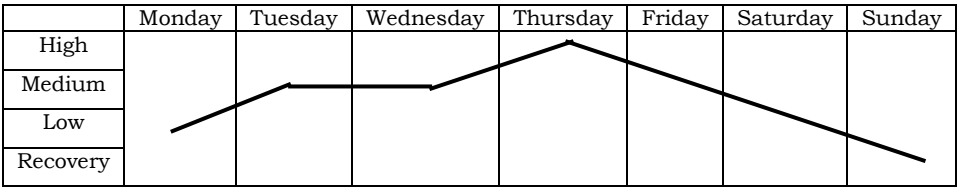


Fig. 10. A Single Peak Level Micro-cycle

Day's Plan

This is the shortest unit in the system of planned training. The plan being the shortest, the content of training is more specific. A plan for the day includes the following:

a) Means and methods of training
b) The exact sequence of exercises of the main programme
c) Stimulus dosage (intensity, density, duration and frequency of stimulus)
d) The salient points of technical and tactical training

A coach should have complete information about the sportsperson so as to develop this plan systematically. It has already been emphasized that optimal performance in a sport is attained only after having been trained over a considerable period of time. To ensure attainment of high performance the training state of a sportsperson is evaluated from time to time adopting the following means:

a) The diary of the coach
b) The diary of sportsperson
c) The result of performance checks and competitions
d) The results of sports doctor's examination.

While developing the training plans, the following four principles of planning have been kept in mind.

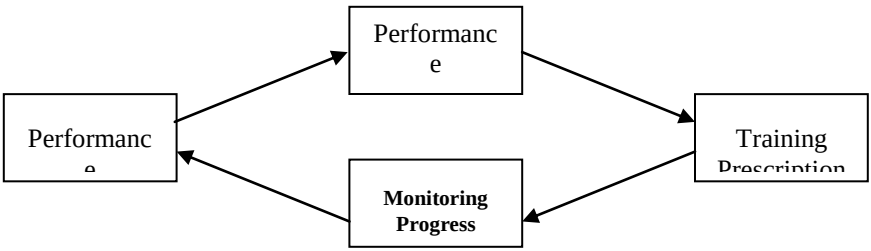


Fig.1. Factors Involved in Programme Planning

Chapter 7

PERIODISATION

Periodisation is the division of the training year into periods so as to systematically prepare and develop the sports form and skills as well as moral and will qualities for the decisive competition. By means of periodisation, different training tasks, training means and methods must be planned and soled logically so that the sportsperson is ready and capable of achieving personal best performance at a fixed time.

During the Olympic or Asian Games year, it has been several times observed that some of the sportspersons create performance comparable to world standards before or after the games but fail miserably during the championships. This generally happens because of mistake in the periodization. Improper planning brings them to top form before or after the main competition but during the competition they fail to make an impact. In view of the above it is important that the competition calendar should be prepared well in advance and made known to the participating teams to enable them to do effective planning. The date and time of the competition has a significant effect on periodization and, therefore, any change in these can disturb the periodization process of the sportsperson.

The training year of the time available for training can be divided into following periods and phases.

1. Preparatory period (6 weeks to 7 months)
    a) General Preparation Phase
    b) Specific Preparation Phase

2. Competition Period (6 weeks to 5 months)
   a) Pre- competition Period
   b) Main Competition Period
   c) Post-competition Period

3. Transition Period (4 to 6 weeks)

The optimum performance achieved by a sportsperson as a result of systematic training is a temporary phase. It cannot be maintained for a very long time. Therefore, the top form of the sportsperson has to correspond with the competition period and one should attain top form at the time of the most important competition. The preparatory period is the phase of base creation, the competition period is the phase of achievement of optimum performance and maintenance of the top form and the transition period is termed as the phase of temporary loss of sports form. This phase provides recovery and relaxation to the sportsperson so that the next year's training can be started without any fatigue.

Types of Periodisation

(1) Single Periodisation
(2) Multiple Periodisation
   (i) Double Periodisation
   (ii) Triple Periodisation

The word single, double and triple refer to number of peak forms reached during the annual plan. In single periodization the sportsperson attains peak form once so as to put up best performance in one most important competition of the year whereas in double and triple periodisation, sportsperson comes to top form twice and thrice respectively for two or three important competitions, separated by long intervals. All the three types of periodisation mentioned above have advantages

and disadvantages. Single periodisation is useful for creating a base for sports performance whereas multiple

(double and triple) periodisations are useful for quick development of sports form.

Single Periodisation

Macro Cycle - I											
Preparatory Period						Competition Period					TP
General Preparation Phase				Special Preparation Phase		Pre-comp. Phase		Main Comp. Phase			
Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug

Double Periodisation

Macro Cycle – I				Macro Cycle - II							
Prep. Period		Comp. Period		Prep. Period		Comp. Period					TP
Gen. Pre. Phase	Sp. Pre Phase	Pre. Comp Phase	Main Comp. Phase	Gen. Pre. Phase	Sp. Pre. Phase	Pre. Comp. Phase	Main Comp. Phase				
Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug

Triple Periodisation

Macro Cycle-I				Macro Cycle- II				Macro Cycle- III				
Prep. Pd.		Comp. Pd.		Prep. Pd.		CompPd		Prep. Pd		CompPd		TP
GPP	SPP	PCP	MCP	GPP	SPP	PCP	MCP	GPP	SPP	PCP	MCP	
Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	

Legends:
GPP-General Preparation Phase
SPP-Special Preparation Phase
PCP-Pre-competition Phase
MCP-Main Competition Phase
TP-Transition Period

Aim and Content of Different Training Periods

Preparatory Period

The aim of this period is to concentrate on development of different factors on which sports performance depends. This phase covers 2/3 of the total training time and thus is the longest period of training. This period is dominated by high volume of stimulus but intensity is medium. It is divided into two or three phases depending upon the total time available for training. Each phase has its own tasks and goals to be achieved. The three phases of preparatory period are:

Preparatory Period I

This phase has the following main tasks:

a) To re-achieve previous training state
b) To make the sportsperson capable for undertaking higher training loads.
c) Base creation for specific performance factors.

In this phase, training is dominated by increase in the volume of stimulus and the training intensity is slightly increased. There is dominance of general exercises and competitions are few in number. This phase lays stress on development of general endurance, strength, flexibility and co-ordinative rather than automatization. Relearning of skills, if needed, is also emphasized during this phase. There is little emphasis on tactical training; stress is an acquisition of tactical knowledge through the theoretical sessions.

Summary of importance points to be kept in mind during this phase:

1) The volume must be high and increased step by step.

2. The intensity should vary from low to medium.
3. Emphasis is placed on the development of general physical performance capacities (endurance, strength, power, speed, mobility etc.)
4. Skill (technique) is not to be overlooked. Work includes correcting major faults, beginning training on key features of a new technical model or simply maintaining the skill that exists.

Preparatory Period II

This phase lays stress on development of those factors on which sports performance depends directly. This phase is dominated by high volume of load and intensity is also increased considerably. There is a dominance of specific exercises. However general exercises still continue. The number of competitions is still small. The motor components developed in the first phase are maintained and emphasis is laid on the development of specific motor abilities. In technical training, stress is on perfection of the skill. The load on tactical training is slightly increased. Theoretical sessions of tactical training still play a dominant role.

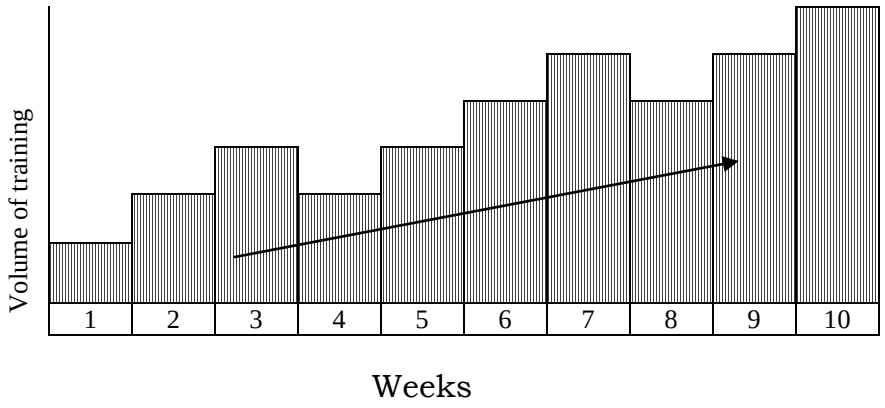
Preparatory Period III

The main task of this phase is to prepare the sportsperson for the competition. Special and competitive exercises dominate and emphasis is an integration of important performance factors. In this phase the volume of stimulus is optimally increased and there is also a sharp increase in intensity of load. The specific and competitive exercises dominate and general exercises are considerably reduced. The number of competitions is increased. The motor factors developed earlier are maintained and emphasis is on further development of specific motor components. Technique training emphasizes on acquiring skill mastery through participation in competitions. Learning of new skills is

avoided. Relearning is continued if started in the earlier phases. Technique training is combined with tactical training. In addition to theoretical sessions of tactical training, tactics are perfected through field training and competitions.

Summary of importance points to be kept in mind during this phase:

1. The volume is still progressively increased until the middle stages of this phase when it begins to decrease gradually.
2. The intensity is progressively increased as the volume begins to decrease.
3. Emphasis is gradually changed from the development of general performance capacities to the development of sport specific fitness.
4. The development of skill changes to new tasks in order to improve technique and to adjust it to the sport specific fitness level for competition readiness.
5. The development of skill and physical capacities must be adjusted in volume to meet individual needs.



Increase of volume in the form of steps.

Competition Period

The main of competition period is to attain top sports performance and to maintain it for a sufficiently long period. The training of sportsperson during this period is organized keeping in mind the following factors:

a) Duration of competition period
b) Performance level of the sportsperson
c) Number of competitions and their dates
d) Frequency of competition
e) Load tolerance ability
f) Individual characteristics.

This period is dominated by loads of high intensity whereas volume of stimulus is low. Specific and competitive exercises dominate and emphasis is laid on proper integration of various factors of performance. Acquiring complete mastery of the skill is emphasized which is tested during competitive situations. In order to use skills intelligently and creatively during competition, stress is also laid on complete tactical mastery. To ensure complete stabilization of tactical knowledge, it is tested through participation in competition. In as much as psychological preparation of sportsperson is essential, development of special psychic abilities needed for successful participation is emphasized. For proper psychological preparation of the sportsperson, it is essential to participate in good number of competitions arranged in a sequence of increased degree of difficulty. In addition to developing psychic abilities, it also helps in achieving top sports form. The sportsperson should systematically carryout direct preparation in too many competitions. Very high frequency of competitions will

interfere with training and will result in loss of sports form.

Summary of importance points to be kept in mind during this phase:

1. The training volume is reduced but intensity remains relatively high.
2. Physical conditioning, with emphasis on sport specific performance capacities, reaches the maintenance stage.
3. Skill development receives its final polish and is evaluated in competition situations
4. Expansion of competitive experience takes place through progressively increased levels of competition without any specific preparations, although some tapering is introduced in the latter stages of this phase.

The main points to be observed in this phase are:

1. The recovery, combined with a short cycle of specific conditioning, should re-establish basic performance capacities.
2. Generally, the limited extent of training in this phase is based on a low intensity, medium level volume in the first part, followed by a low volume, high intensity in the second part.
3. Refinement of skill takes place parallel to specific conditioning but it is too late for major technique changes.
4. The number of lead0up competitions to the climax event must be kept to a minimum to avoid psychological fatigue.

   5.There should be at least a week between the last lead-up competition and the climax event.
5. As additional training will be of little value in the final stages of the main competition phase, it is

better to ease up or even rest prior to the climax event, rather than enter it fatigued.

6. A simple formula for the climax competition over the last 4 weeks is as follows:

Week 1-Recovery and low inte4nsity, medium volume training.
Week 2-High intensity, low volume training.
Week 3-Lead up competition (s) or competition specific training
Week 4-Limited competition-specific training and rest.

Transition Period

After having undergone hard and strenuous training during the earlier two periods i.e. preparatory and competition periods, this period's aims are to provide recovery and relaxation to the sportsperson. Therefore, this period prepares the sportsperson to start the next annual cycle of training after proper recuperation. The duration of the period should not be more than 6 weeks. Transition periods longer than this will result in loss of form, which will have to be compensated by putting in more effort in the following preparatory period. During this Period of training, both volume and intensity of stimulus are kept low. The frequency of training is also reduced and sportspersons are encouraged to go in for deviations i.e. participation in other games and sports. Technical and tactical training is avoided during this period and emphasis is on performing general exercises. During this phase, the training is so organized that the training state of the person is maintained as much as possible but the training means and methods adopted are such that the sportsperson recovers from the hard effort put in during the competition period. This period should be conducted in a way that ensures the sportspersons come into the new season fitter than the last.

The main points to observe are:

1. The recovery should be active to prevent a drastic decrease in physical performance capacities.
2. Specialized programmes to overcome diagnosed weaknesses to maintain fitness and control body weight.
3. The construction of further training plans be based on a careful evaluation of the results of the previous year.

Content of Training for Different Periods

Training Tasks	**Preparatory Periods**			**Compet Perio**
	I	II	III	I
Development of Strength				
a) Maximum. Strength	++++	++++	++	+
b) Explosive Strength	+	++	++++	+
c) Strength Endurance	+	+	+	++++
Development of Endurance				
a) Basic Endurance	++++	++++	++	+
b) Speed Endurance	+	+	++++	++++
c) Sprint Endurance	--	--	+	++
Development of Speed	--	--	+	++
Development of Flexibility	++++	++++	++	++
Development of Technique				
a) Low Intensity	++++	++++	++	+
b) Med. Intensity	++	++	+++	++
c) High Intensity	+	+	++	+++

+ Little Significance
++ Medium Significance
+++ Great Significance
++++ Special Significance.

Chapter 8

PLANNING AND ORGANIZATION OF COMPETITION

Training alone is not enough for a sportsperson to excel in competitions. Only typical competitions like situations are developed in training. In competitions, the energy available in most cases is utilized to a great extent than in training because the demands of competitions are much higher than the demands of training. Hence in order to attain optimal sports performance competitions play a vital role. A coach must be aware of the process of preparation of a sportsperson for a decisive competition, which commences 4 to 6 weeks before the competition and continues just before the start of the competition. He should be well aware of the concept of periodization so as to divide the training time systematically in order to prepare the sports form and skills for the forthcoming competition.

Chapter 8

Planning and Organization of Competitions

Sports have been very closely associated with the human society and thus the competitions in sports have a decisive social, cultural, political and economical influence. This impact of competition has been further strengthened by the use of public media i.e. radio, television and press. Sports competitions can be considered in two ways:

1) As a final goal of sports training.
2) As a means of quick development of sports form.

Training alone is not enough for a sportsperson to excel in competitions. Only typical competition like situations are developed in training. In competitions, the energies available in most cases are utilized to a great extent, than in training. The demands of the competition are much higher than the demands of training. Hence in order to attain optimal sports performance competitions play a vital role.

Correct tactical thought and action (distribution and utilization of various motor abilities, selection and timely application of technical means) self control during the competition, mastery of inner urge and assessment of real performance capacity etc. are learnt by the sportsperson, after careful build up in training, only during competition. Therefore, competitions are indispensable for the development of sports form.

A single competition cannot serve as a preparation for all possible contest situations. The exact number of competitions in a sport will depend upon the nature of sport, age of the sportsperson, training age of the sportsperson, level of performance, ability to withstand

competition load, level of motor abilities, technique, tactics and will qualities of the sportsperson. Therefore, one should participate in adequate number of competitions against individuals or teams of different performance level and also against unknown opponents. If a sportsperson always competes against known opponent, a system of stereotype motor behaviour patterns but fails when the conditions of competition change. Participation in competition develops the ability of a sportsperson to adjust quickly to various competition situations, which change frequently.

The number and degree of difficulty of competitions should increase from year to year. A fully trained sportsperson should participate in as many as 20 to 50 competitions in a year out of which 3 to 4 will be main competitions and remaining major and preparatory (build-up) competitions. However, if the frequency of competition becomes very high i.e. exceeds the limit indicated above, it will interfere with the normal training programme and the sportsperson will not be able to train himself as per the planned schedule.

Frequency of Competitions

The frequency of competition depends uon the sport, the capacity of the sportsperson and his training age. In speed and explosive strength dominated sports the frequency of competition is high. The sportsperson can participate in one to two competitions per week. In the case of sports, which require more endurance and strength endurance, the competition should be less frequent. An interval of about two weeks is needed between two competitions. Keeping the above suggestions in mind, a sportsperson should participate in 20 to 30 competitions in a year. The following suggestions must be kept in mind.

1. A sportsperson should participate in competition only if he has properly prepared for it and he has complete physical, mental, technical and tactical preparation.
2. The degree of competition should be gradually increased.
3. Competition with opponents of equal and higher performance standard must be arranged. Competitions, which do not put high demands, are of no value.
4. The frequency of competitions should be such that the normal training is not disturbed. Every competition needs systematic preparation.
5. The schedule of competition should be such that the sportsperson attains peak performance at the time of main competition.

Classification of Competitions

The competitions can be classified into the following three types:

1. Main Competitions: These are the most important competitions for the sportsperson and during these the sportsperson must achieve optimum level of performance. Olympic Games, Asian Games, Commonwealth Games and World Championships are classified under this category. There should be 3 to 4 main competitions in a year and they should be well distributed with regard to time. These competitions fall outside the sports training process.

2. Major Competitions: These competitions are also significant but are less important as compared to the main competitions. For a high performance sportsperson the national championship and competitions conducted for selection of teams for the main competitions are termed as major competitions. These competitions form a part of the training process of a sportsperson.

3. Preparatory (Build-up) Competitions: These competitions are used as means for development of sports performance for the major and main competitions. They fall within the process of sports training. Each preparatory competition must have its own goal that must coincide with the training tasks for the corresponding period of training.

Such tasks could be:

a) Getting used to contest situations.
b) Development and testing of definite motor quality
c) Testing technique
d) Executing definite tactical task
e) Getting used to definite competition sites
f) Development of self-confidence

The build-up competitions are spread over the entire training year. During the preparatory periods these competitions must be planned in such a way so that the sportsperson is confronted with increasing. Build-up competitions during preparatory periods should develop general sports form e.g. running competitions for throwers, jumpers, football players and weightlifting competitions for throwers, rowers, wrestlers and boxers.

Direct Preparation for a Decisive Competition

Direct preparation for an important competition begins about 4 to 6 weeks before the competition. This preparation is aimed at adjusting the sportsperson to the specific conditions (technique, tactics, will power, moral etc.) of the main competitions or even a major competition so as to raise the performance level to an optimum extent and stabilizing the already attained form. Along with achieving high performance, this preparation also focuses attention on removal of deficiencies of the sportsperson. For direct preparation for a decisive competition, a special meso cycle should be

used and the last week (micro cycle) of the meso cycle must guarantee that the sportsperson will participate in the competition in a state of supercompensation.

As a part of direct preparation, the sportsperson should get adjusted to the following conditions of competition.

1. Adjustment to the Opponent:

A sportsperson should participate in preparatory (build-up) competitions with similar opponents (if possible with the same opponent) so as to know the typical features and strong and weak points of the opponent.

2. Adjustment to Competition Time and Duration:

Efforts should be made to arrange preparatory competitions at a time of the day when the actual competition is to be held. These competitions should also be played for the actual duration of the game.

3. Adjustment to Competition Rules:

Through participation in build-up competitions, where the competition rules to be followed will be exactly similar to that of the main competition, the sportsperson should adjust him to the rules of the competition. If he fails to do this, he will not be in a position to intelligently use skills during the competition.

4. Adjustment to Competition Apparatus and Equipment:

The organizers of the competition invariably specify the apparatus and equipment to be used during the main competition. The sportsperson should use the same equipment while participating in the preparatory competitions. A sudden change in the sports apparatus and equipment affects the performance negatively.

5. Adjustment of Special Features of the Competitions Site:

Special features of the competition site namely size of area, colour of the playing surface and the surroundings, the height of the playing arena, water conditions, wind conditions, temperature, humidity etc. have a direct effect on the performance of a sportsperson. During preparatory competitions a sportsperson should participate under conditions similar to that of the main competition site.

6. Adjustment to Daily Rhythm (Biological Rhythm):

The human biological clock is so well adjusted that he can put up his optimal performance at a specific time of the day. Once the actual time of the main competition is known the sportsperson should participate in the preparatory competitions at the same time so that his biological clock gets adjusted to the time of the main competition.

7. Adjustment to Climatic Conditions:

It is a common practice among the organizers of competition to intimate the participants regarding the climatic conditions during the days of the competition. This enables sportsperson, if possible, to participate in build-up contests under similar climatic conditions. Participating teams, some times, reach the place of competition few days in advance of the start of the main competition so as to get acclimatized.

As a part of direct preparation for an important competition, the technical training should be systematically planned because mistake developed in this phase cannot be easily rectified. Before planning the training the training programme for this important phase, the coach must have a clear idea about the load during the previous meso cycle and then work

systematically to increase it is case the sportsperson was training with high load, the same load be maintained, so as to consolidate the performance.

Preparation During the Last Week

The coach, the sports doctor, the physiotherapist should all work together and jointly influence and help the sportsperson. The closer is the jointly influence and help the sportsperson. The closer is the competition, more intense is the psychic process. On one hand the sportsperson is to concentrate on the competition and on the other hand he is afraid of the contest. With the help of the sports doctor/physiotherapist certain physio-therapeutic measures (massage, sauna and contrast bath) can be used for enhancing or lowering the state of activation. Sportsperson should always be kept with the group and should be kept occupied in some kind of activity so that he does not think about the competition. This is the best way to avoid increase in the level of anxiety. The coach himself should avoid getting over-excited because this will have a bad affect on the sportsperson.

During the last week of training, the organization of the day should be done as follows:

a) Training
b) Massage
c) Relaxation
d) Stimulating talk
e) Occupation in some kind of work
f) Witnessing a cultural event
g) Reading of literature
h) Participation in a social event.

The last one or two days prior to the competition are very crucial. By now all the important components of

performance (physical, technical, tactical etc.) are developed to optimal level and the preparation in respect of these is almost over. However, the psychological preparation of a sportsperson continues. The main purpose of the psychological preparation in this phase is to enable the sportsperson to attain optimum readiness for participation in the main competition.

Preparation Before Start of the Competition

On the day of the competition the psychic process of the sportsperson reaches the climax. The sportspersons who are afraid of the competition should not be left alone. They should be kept with the team. Certain psycho-regulation procedures may be adopted to lower the level of excitation. At the last minute the tactical plan can be discussed and the apparatus to be used in the competition can be examined.

Depending upon the nature of the sports and the climatic conditions, the sportsperson should begin warm-up 30 to 45 minutes before the competition. Depending upon the habit of the sportsperson, he may warm-up alone or along with the teammates. he may warm-up at the competition arena or away from it. The sportsperson should begin with general warm-up then switch over to specific preparation. The specific warm-up should end performing few attempts of the actual activity at the competition site. About 5 to 8 minutes rest between warm-up and start of competition should be taken by the sportsperson so as to mentally prepare for the contest.

Chapter 9

EVALUATION OF TRAINING

Planning is an effective means of ensuring continuous development of sports performance and it enables a sportsperson to achieve highest possible standard of sports performance. Planning, evaluation and sports performance constitute a unit. The purpose of evaluation is to check the progress being made in implementing the training plan and above all to find out how efficient the training methods, means and the load structure had been.

For this purpose it is necessary to record the training indices and the performance achieved in tests and competitions. The obtained data is compared with the tasks set out in the plan and in cases of major deviations the coach should try to find out the reasons and to draw conclusions for future phases of training. Other means available for evaluation are the coach's notes on athlete's behaviour in training and competition and on the quality of standard of technical skill, which are recorded in the training diary and result of performance diagnostics. The coach must select the essential data and determine the methods and techniques, which he is to use in order to obtain information in the course of the training year for evaluation purposes.

One of the very important tasks of a coach is to set goals and then work systematically for their attainment. These goals could be immediate, intermediate and final goals. The only effective way to ascertain whether the training programme has been effective in the attainment of goals is to carry out evaluation at regular intervals. After having fixed the goal, a coach with the help of sports science experts will evaluate the sportspersons periodically to ascertain the progress being made. The factors interfering with the progress are identified and appropriate ways and means are adopted to remove all hurdles to ensure progress.

Availability of sports talent, application of appropriate means and methods to identify talent and presence of technical persons who are aware of the scientific methodology to groom the talent are the important pre-requisites in case a country even thinks of having sports teams who can match the international standards. In order to win sheer talent is not enough. Talent alone contributes to about 30% performance and the remaining 70% comes from effective and well-organized scientific training. The famous adage 'catch them young and coach them right' supports the above view. Many potential children who had all the pre-requisites and the desire to become hockey players failed to attain heights solely because they had not been groomed properly. Since sports training has become very complex, a hockey coach alone is not in a position to tackle varied problems confronted by sportspersons. The problems faced by hockey players are so diverse; a team of experts is needed to find appropriate solutions. Hockey coach is the most important member of this team. The other members of the team comprise of experts in different sports science disciplines namely Science of Sports Training (GTMT), Exercise Physiology, Sport Psychology, Sports Medicine, Sports Bio-mechanics, Sports Anthropometry, Sports Nutrition, Sports Sociology

and the like. By no means an effort is made to undermine the efficiency of the hockey coach. In fact, all the above sports science experts will support the hockey coach by providing scientific inputs that commensurate with the problem being confronted.

An expert in Science of Sports Training (GTMT) will help the coach to work out short and long-term training programmes. He will also assist in ascertaining target-training zones so as to correctly administer training loads as per the ability of a hockey player in order to make the load effective. He will also help in working out load-recovery ratio. An exercise physiologist will examine how different body systems react to various training regimens, how adaptation process takes place and determine factors that limit adaptation. A sports physician will suggest measures to prevent injuries, correctly diagnose and prescribe treatment to enable the hockey player to return to training sessions at the earliest. A sports psychologist studies and analyzes the behaviour of hockey players during training and competition. He would assist in psychological skill training that helps in goal setting, arousal management, imagery training, improving confidence and enhancing concentration. Sports Bio-mechanist contributes by analyzing physical movements of hockey players in the light of principles of mechanics. The kinematic and kinetic principles are applied to sports performances in order to elicit better results. Cinematography is being used as an effective tool in analyzing the skills of the players.

At higher levels of performance, the hockey players have similar endowed abilities and train along similar lines. Among others, one of the determining factors in the success of players is nutrition. It is our food intake that ultimately determines our physiological functioning. In this regard, a sports nutritionist is of great help for the

hockey coach. He helps in working out pre-competition, competition and post-competition diets for the players. An expert in sports anthropometry deals with the relationship between shape, size and form of the body and body parts, and sports performance. An expert in sports sociology contributes by identifying the social factors that influence sports performance and vice-versa.

There are numerous examples of hockey players who have excelled without inputs from various sports science disciplines and also there are hockey players who have risen to highest proficiency without a hockey coach. All these are the stories of the past and they do not lay down basic principles and theories. These are termed as exceptions. The purpose here is not to highlight the superiority of one group of experts over the other, in fact it is an effort to come on a common platform so that the hockey players can be helped to a maximum extent and their potential can be groomed in the most effective way.

Numerous examples can be cited of international hockey teams who have employed sports scientists of different disciplines to assist them. The recent trend is to attach a team of sports science experts with players during their long-term training process. Some of these experts also accompany the teams in order to tackle problems confronted by the players at the competition venue.

One of the very important tasks of a hockey coach is to set goals and then work systematically for their attainment. A sportsperson or a coach who does not set a goal is like a ship in the sea without knowing in which direction it is to move. These goals could be immediate, intermediate and final goals. The only effective way to ascertain whether the training programme has been effective in the attainment of goals is to carry out evaluation at regular intervals. This evaluation could be formative or summative. Formative evaluation is the

judgment conducted during the training programme where as summative evaluation is the final, comprehensive judgment conducted near the end of training programme. After having fixed the goal, a hockey coach with the help of sports science experts will evaluate the players periodically to ascertain the progress being made. The factors interfering with the progress are identified and appropriate ways and means are adopted to remove all hurdles to ensure progress. The following purposes may be achieved through evaluation:

Talent Identification: With the help of appropriate evaluative procedures, the potential players can be identified.

Placement: Initial evaluation allows a hockey coach to divide the players into training groups according to their abilities. The training loads can be effectively planned when hockey players are in equal ability groups.

Diagnosis: Evaluation facilitates in the identification of weaknesses and deficiencies of players. Hockey coaches and sports science experts may work together to identify weak points and take appropriate steps to remove them.

Prediction: An experienced hockey coach, in consultation with sports scientists may successfully predict future results and trends based on present and past data.

Motivation: Evaluation is an effective tool for the motivation of players and sustaining their interest in the training process. There would not be any sportspersons if there were only practice and no games or competitions.

Achievement: In a training programme, evaluation facilities in determining the extent to which, the goals

have been achieved. Attainment of objectives reflects the achievement level of the players.

Programme Evaluation: Attainment of objectives and aim would reflect the effectiveness of coaching programme. Evaluation is an effective tool to ascertain the extent to which objectives have been realized.

There are several countries, which enjoy genetic advantages, and there are also quite a few nations who have environmental benefits. Unfortunately Bangladesh does not come in any one of the above two categories. Bangladesh has to only depend on the selection of talented hockey players at a younger age and thereafter groom their talent through scientific coaching. To enable the potential sportspersons to attain sports performances comparable to international standards, the only effective way is that the hockey coaches and sports scientists work together.

The evaluation should include the following items:

1. Assessment of the development of sports performance and of individual aspects of sports efficiency. Special attention should be paid to the level of basic ideological conviction and to all personality features, to the degree of command of sports skills and co-ordination that play an essential role in improving performance efficiency.

2. The load indices and their dynamic pattern as well as the causes of deviation from the individual plan and the effectiveness of load on developing sports efficiency.

3. Assessment of the development of load tolerance based on observations during training and competitions and also on performance diagnostics.

4. Assessment of sportsperson's ability to cope up with the requirements of training and competitions as well as with curricular and vocational requirements.

5. Assessment of the rate of progress made by the sportspersons in acquiring new knowledge.

6. Assessment of collective development and of social relations in the group.

USES OF GRAPHS

Graphic diagrams are an important means of planning and evaluating the training process. They give the coach an access to various indices at one glance and make it easier for him to recognize certain relationships.

Principles of Graphical Representation

1. Quantification and symbols
   To represent phenomena graphically it is necessary to quantify and symbolize them. Lines of different thickness, continuous or dotted lines, different colours can be used as symbols.
2. Selecting the scale
   It is important to choose the right scale in order to achieve maximum clarity. The scale is determined by the biggest variable to be represented. The scale should be as large as possible in order to be able to make direct comparisons of the features.

3. Emphasis on clarity
   The graph should not include too many variables at one time. In case a large number of indices are to be included, pie diagram may be preferred.

Forms of Diagram Used for Evaluation

The following diagrams are used

1. Curved diagrams (Polygon)
2. Histograms
3. Bar diagrams
4. Area diagrams
5. Line diagrams

CHECKING PROGRESS

It is important to determine the influence of training load and of other measures on the development of sports efficiency and individual features of sports abilities in order to organize training in an effective manner. For this purpose the level of general and specific sports performance should be checked at regular intervals. This is done with the help of two methods namely progress checks and tests.

1. Progress Checks
   Progress checks are used mainly for determining performance indices for making direct assessment of the level of performance. They are an integral part of training process. The results obtained with their help and with the help of tests constitute and important basis for planning, guiding and controlling sports training.

   Based on the results of performance it is also possible to evaluate the level of training and the development of essential individual abilities, skills, and faculties such as condition, coordination,

technique and tactics, knowledge and competitive psychological characteristics.

Progress checks are to be carried out under the management of the coach with the assistance of sports science experts namely expert in science of sports training, sport psychologist, exercise physiologist, sports bio-mechanics expert, sports medicine expert etc. in order to obtained complex analysis of sports performance.

Benefits

i) Progress checks enhance training and have a positive bearing on the education of sportspersons. Each progress check gives the sportsperson information about whether or not he has made sufficient effort during training to meet the requirements. He recognizes his own weaknesses and strengths and can compare his development with others.

ii) Performance checks are the conditions for the individual planning of the training programme. Sports training is an individual process.

iii) Progress checks enhance purposive training

iv) Progress checks promote organization of training. Based on analysis, larger groups can be sub-divided into smaller groups and then training can be effectively organized. The purpose of differentiated amount of training is to prevent over taxing weaker sportspersons and not to put stronger sportspersons at a disadvantage.

v) Progress checks support the sportsperson's tuition Load requirements and their typical features can be individually adjusted on the basis of information obtained through progress checks. The coach can assign particular tasks in terms of

quality and quantity to each sportspersons who can then check their fulfillment on their own. This promotes independence and cultivates conscious training habits.

2. **Sports Tests**
The term 'sports test' denotes a standardized method of measurement or testing designed to obtained reliable information on performance and training methods with the help of performance motor tasks. It is possible to measure and objectify individual abilities associated with technical skills with the help of sports tests by carrying out a mathematical statistical analysis based on the criteria of reliability, objectivity and validity and by using scientific methods of examination.

Rules Governing Performance Checks and Tests

1. Performance checks and tests help to put training on a systematic basis. The dates and types of performance checks have to be clearly stated in the individual training plan. One should see to it that checks are carried out properly and regularly.

2. Clear guidelines on the procedures to be followed in checking performance should be drawn up. In this way it is ensured that uniformity is maintained when making repeat performance checks. This is a very important point to bear in mind if the results are to be useful for purposes of evaluation and comparison.

3. The sportspersons should be thoroughly familiarized with the conditions under which the performance checks and tests are to be conducted and accustomed to them in training. The coach should explain to them the purpose and meaning of performance checks and tests. He should point

out to them the necessity of maintaining uniform conditions.

4. The coach should teach the sportspersons to make sure that their fellow-sportspersons abide by the rules. In this way they will give him valuable support in preventing deviations from the set pattern. The coach should himself be consistent in assessing the results. He should not tolerate attempts by sportspersons to look for short cuts, which in the long run can only be detrimental to them.

5. The coach should announce the results of performance checks and tests to the sportspersons and assess them together. The execution of the performance checks should also be assessed.

6. The coach should make his own contribution in ensuring that the performance checks and tests are conducted exactly in accordance with the rules drawn up by him by making through preparations. When testing abilities of strength, for instance, only equipment that has been properly calibrated or weighed should be used. He should mark the equipment that he issues for performance checks and tests.

7. The coach should motivate the sportspersons before such performance checks and tests and remind them of their importance.

Chapter

ENVIRONMENTAL FACTORS AFFECTING PERFORMANCE

Environmental factors namely hot and cold climates, altitude, air pollution, travel stress and like exercise marked influence on the performance of the sportspersons. Some of these factors have adversely affected performance of sportspersons whereas some of the factors have even proved to be beneficial. Extreme heat and humidity can lead to decrease in endurance performance, induce profuse sweating, which may lead to dehydration and even some time may end up in collapse of the sportspersons. This problem has invariably noticed among the marathon runners. At high altitude, in view of low oxygen pressure the oxygen transport system may be severely limited thus causing an adverse effect on endurance performance. During the Mexico Olympic Games (1968), which were held on a high altitude (2250m), the athletes in endurance events suffered due to this problem. At the same venue, because of less gravitational pull, the athletes in jumping events had slight advantage. The air pollution, which a serious problem in many of the big cities, can have a detrimental effect on the performance of sportspersons. Sudden exposure to hot and cold temperature, high altitude and pollution can become a great hazard for the health of sportspersons. Traveling to various countries, which involve change of time zones, particularly to places to which the sportsperson has not acclimatized, can lead to reduction in the performance level. In view of the above it is important for the coaches and sportspersons to get familiar with the physiological responses to each of the above environmental problems so that sportspersons may optimize their performance in the above environmental conditions.

Altitude

At high altitudes the active muscles are partially starved of oxygen.

GLOSSARY OF IMPORTANT TERMS

Active Flexibility-It is the ability to perform movement with greater range without external help i.e. with the help of muscular force.

Active rest-It is a period in which the sportsperson allows the body to recuperate by reducing the amount of training load or doing other physical activities to maintain sports form.

Acceleration Speed-It is the ability to increase speed from jogging to running and finally sprinting.

Adaptation Ability-It is the ability of a sportsperson to bring about effective change in the movement according to anticipated changes in situation.

Aerobic activities-Activities using large muscle groups at moderate speed.

Agility-It is the ability of the human body to change direction quickly and effectively.

Anaerobic activities-Activities using muscle groups at high intensities that exceed the body's capacity to use oxygen to supply energy and which create an oxygen debt by using energy produced without oxygen.

Anaerobic threshold-The point at which blood lactate concentrations starts to rise above resting values.

Auxiliary exercise-Exercise that works a specific muscle or group of muscles to complete total body strength or to isolate a specific muscle area.

Balance-It is the ability of the body to maintain equilibrium in static and dynamic conditions.

Basal metabolic rate-The minimum energy required to maintain the body's life functions at rest.

Basic Endurance-It is the ability of the organism to resist against fatigue in the case of endurance loads of medium intensity of stimulus and mainly aerobic muscular metabolism.

Biofeedback-Helps people reduce their response to stress by enabling them to become more aware of their level of psychological arousal.

Bounding-It is described as a takeoff and landing movement from one leg onto the other leg.

Calorie-It is the energy required to raise the temperature of one kilogram of water one degree Celsius. Also called a kilocalorie (kcal).

Carbohydrate-Chemical compound of carbon, oxygen and hydrogen, usually with the hydrogen and oxygen in the right proportions to form water.

Cardio-respiratory Endurance-This is the quality that enables one to continue engaging in reasonably vigorous physical activities for extended periods of time where the required cardio-respiratory adjustments to the activity are built up.

Circuit Training-It is training method by which exercises of various kinds are performed in sequence with or without apparatus after having given a dosage planned before hand and interspersed by intervals.

Coaching-It is described as a technical skill which involves co-ordination of factors like time sequence, action movement and speed so as to enable a sportsperson to attain highest level of efficiency in a specific sport.

Competition-A situation when attainment of a goal by one participant prevents the other participants from attaining it.

Concentration-The ability to focus one's attention on the task at hand and thereby not disturbed or affected by irrelevant external and internal stimuli.

Concentric contraction-In this contraction the muscle shortens with varying tension while lifting a constant load.

Conditioning-is a process of gradually preparing the body for strenuous physical activity thus focusing attention on development of physical and motor fitness components (strength, speed, endurance, flexibility, co-ordinative abilities) and indirectly enhancing sports performance.

Confidence-The general belief in individual's ability to perform well and win the game; a task-specific belief in the individual's ability to pass, run, tackle, and execute.

Contraction-The reaction of the muscle as it works against a resistance, shortening of the length of a muscle.

Cool down-A gradual reduction of the intensity of exercise to allow physiological process to return to normal. Also called warm-down.

Combinatory Ability-It is the ability of a sportsperson to systematically and meaningfully combine the movements of different body parts for successful performance of sports movements.

Cooperation-A situation in which attainment of a goal by one individual is positively correlated with attainment of that goal by other members of the group.

Co-ordination-It is the ability to perform movements of various degrees of difficulty very quickly and with efficiency and accuracy.

Co-ordinative ability- Relatively stabilized and generalized pattern of motor control and regulation process that enables a sportsperson to do a group of movements with better quality and effect

Core exercises-Exercises that work the main muscle groups and serve as a base for all strength-training programmes.

Depth Jumps -This method involves jumping down from a height and then jump forward for distance or jump up for height..

Detraining-The process of losing the benefits of training by returning to a sedentary life.

Differentiation Ability-This is the ability which enables a sportsperson to achieve high degree of perfection and economy of separate body movements and movement phases in a motor action.

Diuretic-Any agent, which increases the flow of urine, ridding the body of water.

Duration Load Method- Those methods of training in which uninterrupted medium to sub-maximum intensity loads are maintained for a relatively longer period of time.

Dynamic Flexibility-It is the ability to perform movements with large amplitude when the body is in motion.

Eccentric action-Muscle action in which the muscle resists while it is forced to lengthen.

Endurance-The capacity to continue a physical performance over a period of time.

Exercise-Physical exertion of sufficient intensity, duration and frequency to achieve or maintain fitness, or other health or athletic objectives.

Explosive Strength –It is the ability of muscle to get over resistance of sub-maximum intensity of stimulus as fast as possible.

Extension-A movement, which moves the two ends of a jointed body part away from each other, as in straightening the arm.

Fartlek-It is used to describe cross country runs where the steady speed of ordinary cross country running is changed into a mixture of faster and slower phases, each covering a different distance over natural terrain according to the individual approach of the sportsperson.

Fatigue-A loss of power to continue a given level of physical performance.

Feedback-Information that sportspersons receive from their coach/trainer or environment regarding the level of their performance.

Flexibility-The athletic ability to extend, move, or rotate body parts in a full range of motion.

Flexion-A movement, which moves the two, ends of a jointed body part.

Free weights-Barbells and dumbbells that can be used many ways without restrictions.

Frequency-The number of times per week, day or season a sportsperson trains.

Glycogen-The storage from of carbohydrate. Glycogen is used in the muscles for the production of energy.

Goal-Specific standard of proficiency achieved in a particular area of performance within a specified time.

Goal setting-One of the good foundations of a successful psychological skills training (PST) programmes.

Heart rate-Number of heart beats per minute.

Hemoglobin-The iron-containing pigment of the red blood cells.

Homeostasis-Human body's attempt to keep itself in a balance

Hop-It is described as a take off and landing movement from one leg onto the same leg.

Hypertrophy-The increased size of muscle gained through exercise or strength training.

Inner load-It is the reaction of the individual caused as a result of undertaking the outer load.

Intensity-How heavily an exercise is performed.

Interval Method-It is a method of endurance training, which involves repeated efforts art at a relatively faster pace separated by measured intervals of incomplete recovery.

Isokinetic contraction-This procedure involves development of maximum tension in the muscle, which shortens at constant speed at all angles over the full range of motion.

Isometric contraction-In this contraction tension is developed in the muscle working against resistance but there is no change in the length of the muscle.

Isotonic contraction-A muscle contraction against a constant resistance, as in lifting a weight.

Lactic acid-The end product of the metabolism of glucose (glycolysis) for the anaerobic production of energy.

Load-The amount of weight (resistance) an athlete is using during exercise execution.

Maximal heart rate-The highest heart rate of which an individual is capable.

Maximal oxygen uptake-The highest rate of oxygen consumption of which a person is capable, usually expressed in milliliters of oxygen per kilogram of body weight per minute.

Maximum Strength –It is the ability of muscle to get over resistance of maximum intensity of stimulus in a single muscular contraction.

Mental skills training (MST) and psychological skills training (PST)-Designed to prepare, educate and train athletes various technical, tactical, physiological and psychological skills in achieving peak performance towards excellence.

Muscular Endurance- This motor component enables a person to sustain localized muscle group activities for extended periods of time.

One repetition maximum (1 RM)- The maximum resistance with which a person can execute one repetition of an exercise movement.

Orientation Ability-It is the ability of a sportsperson to analyze and change the position of the body and its parts in time and space in relation to performance area or a moving object.

Outer load-It refers to type of physical exercise, quality of exercise execution, intensity of load (intensity and

density) and volume of load (duration and frequency) of motor stimulus.

Over Load- It refers to physical and psychic daily load of life that exceeds the loading capacity of the individual.

Over training-A point at which the sportsperson reaches a plateau or reduction in performance.

Passive Flexibility-It is the ability to perform movement with greater range with external help e.g., doing stretching movement with the help of a partner.

Periodisation- Division of the training year into periods so as to systematically prepare and develop the sports form and skills as well as moral and will qualities for the decisive competition.

Physical fitness-A dynamic state of energy and vitality that enables one to carry out daily tasks, to engage in active leisure time pursuits, and to meet unforeseen emergencies without undue fatigue.

Plyometrics-Is known as the stretching shortening cycle, or myotatic stretch reflex, in which the muscle is loaded in an eccentric (lengthening) contraction, followed immediately by a concentric (shortening) contraction.

Power-It is the quality of a muscle to contract forcefully in the quickest possible time.

Progressive relaxation-It is a form of deep muscle relaxation, which consists of a series of exercises involving, tensing and relaxing the major muscle groups in the body.

Progressive resistance-A system of strength training that progressively and gradually increases the resistance.

Reaction Ability-It is the ability of a sportsperson to respond quickly to a given stimulus and execute well-directed actions following a signal.

Reaction Speed-It is the ability to respond to a give stimulus as quickly as possible.

Recovery-The time necessary for muscles to recuperate after a workout.

Repetitions (reps)-The number of times an exercise movement is repeated.

Repetitions maximum (RM)-The maximum weight that can be used for a specific number of repetitions.

Rhythm Ability-It is the ability of the sportsperson to understand the rhythm of movement and to execute the movement with required rhythm.

Set-A group of repetitions of an exercise movement done consecutively.

Skill-It is the ability to execute movement or movements of different games and sports in a way that the movements take place automatically without a fault.

Speed-It is the ability to make rapid movements of the same type in the shortest possible time.

Speed Endurance-It is the ability of the organism to resist against fatigue in the case of endurance clods of sub-maximum intensity of stimulus and mainly

anaerobic gaining of energy and maximum loss of oxygen.

Speed of Movement- The maximum speed of contraction of a muscle or a chain of muscles in a single course of movement.

Sports training-It is a process of sports perfection directed by scientific and pedagogic principles and aims at leading a sportsperson to high and top level performance in a sport on an event by means of planned and systematic improvement of performance capacity and readiness of performance.

Sprint Endurance-It is the ability of the organism to resist against fatigue during endurance load of maximum intensity and maximum motor frequency.

Sprinting Speed (Locomotor Speed)-It is the ability to maintain maximum speed of locomotion over as long distance as possible for maximum possible duration.

Static Flexibility-Ability to perform movements with large amplitude from a stationary position i.e. standing, sitting and lying.

Strategy-It is the overall plan of a sportsperson to successfully participate in competition.

Strength-It is the ability of a muscle to get over resistance.

Strength Endurance –It is the ability of muscle to get over resistance of medium intensity of stimulus for as long time as possible.

Strength Endurance-It is the ability to the muscle to get over resistance in the cased of loads of medium intensity of stimulus for as long time as possible.

Style-It is the individual expression of skill.

Tactics- It means intelligent or creative application of skills during a competition.

Technique-It is a scientific and economical method to attain high sports performance.

Training Load-Physiological and psychological demands placed on the individual through motor stimulus (movement) resulting in improvement and maintenance of performance capacity.

Training Means-Different variables and measures, which help in the attainment of high sports performance.

Training Method- Systematically planned and effective procedures adopted for the formulation of training process and are characterized by utilization of methods for imparting training content so as to ensure development of performance.

Training Plan- It is a binding directive for developing training condition where all required measures are recorded in writing.

Volume-The total work performed during training per workout, week, or season.

VO_{2max} –Maximum volume of oxygen consumed per unit of time.

Warm-up-A gradual increase in the intensity of exercise to allow physiological processes to prepare for greater energy outputs.

Weight progression-A systematic way of increasing the weight from one set to the next.

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