Principles of Athletic Training

Dr. Anindita Singha Roy

B.Sc.(Hons), M.Sc., Ph.D.,

Assistant Professor
Department of Physiology, Katwa College

Principle of Exercise Training

TERMINOLOGY

- Definition of 1 RM
- Muscular strength
- Static strength
- Dynamic strength
- Muscular endurance

Principle of Exercise Training

TERMINOLOGY

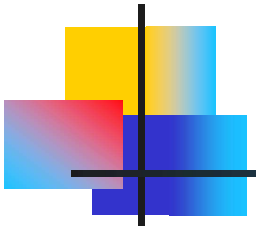
- One-Repetition Maximum (1 RM)
  - Maximum weight lifted one time
  - Dynamic procedure to measure muscular strength
- Procedure to measure 1 RM
  - Guess the weight that can be lifted
  - Progressively add load to the exercise device in subsequent attempts
  - Weight increments usually range between 1-5 kg
  - Rest interval is 1-5 min

Principle of Exercise Training

TERMINOLOGY

- Muscular Strength
  - Maximal force that a muscle or muscle group can generate is termed **Strength**
- Muscular Power
  - Rate of performing work
  - It is the product of Force and Velocity
  - **Power** = Force x Velocity or Speed
    = Strength x Distance / Time

Principle of Exercise Training



TERMINOLOGY

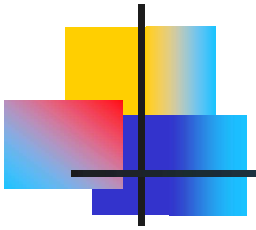
- Significance of **Strength** and **Power**
  - **Strength** is an important component of performance
  - **Power** is even more important for performance
  - One player with more strength may not be able to compete with an opponent who is having more Power but less Strength

Principle of Exercise Training

TERMINOLOGY

- Muscular Power
  - It is the product of strength and speed of movement
  - Force = Strength x Speed
  - Power = Force x Distance / Time

Principle of Exercise Training



TERMINOLOGY

- Muscular Power
  - It is measured by assessing the maximum number of repetitions one can perform at a given percentage of his / her 1RM
  - Anaerobic Power
  - Aerobic Power

Principle of Exercise Training

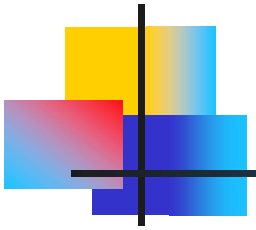
TERMINOLOGY

- Muscular Endurance
  - The capacity to sustain repeated muscular contractions at a submaximal work-load
  - Several laboratory techniques are available to measure muscular endurance
  - The easiest way is to assess the endurance capacity by asking the individual to perform the maximum repetitions at a given percentage of 1 RM.

GENERAL PRINCIPLES OF TRAINING

A. Principle of Individuality
B. Principle of Specificity
C. Principle of Reversibility
D. Principle of Progressive Overload
E. Principle of Hard / Ease
F. Principle of Periodizatoin

Principle of Individuality



- Each person is recognized as unique
- Training programme should be designed to allow for individual variation
- Heredity plays a major role
- Response to training programme varies in each and every individual
- Individual adaptability to training programmes occurs in different ways and different extents

Principle of Specificity

- Acute responses and adaptations to training programmes are highly specific to
  - the type of activity
  - the volume and intensity of exercise performed
- Training must specifically match to the type of activity athlete is engaged in
- Specific training protocols are designed to optimize the critical adaptation of the physiological parameters relevant to the specific event

Principle of Reversibility

- Lends scientific support to the saying “use it or loss it”
- Decrease or stop of training reverses back the adapted parameters to the sedentary level
- A training programme must have a maintenance plan

Principle of Reversibility

- Lends scientific support to the saying "use it or loss it"
- Decrease or stop of training reverses back the adapted parameters to the sedentary level
- A training programme must have a maintenance plan

Principle of Progressive Overload

- Gradual increment in training load to continue the adaptation
- As the body adapts, training progresses to even higher levels

Principle of Hard or Ease

- Training hard includes training each day
  - A high intensities
  - For a longer duration
  - Both
  - But this causes maladaptation
- To avoid such maladaptation
  - One or two days of hard training is followed by one days' easy training
  - This allows the body and mind to recover totally before next hard training

Principle of Periodization

- Concerned with resistance training
- It is the designing of gradual cycling of
  - Specificity
  - Intensity
  - Volume of training
- One training macrocycle is divided into 2 or more mesocycles that is in turn divided into
  - Periods of preparation
  - Period of competition
  - Period of transition
- All this subdivisions are dictated by the dates of major competition

RESISTANCE TRAINING PROGRAMME

Designing Resistance Training

- The needs analysis is the first step to design a resistance training
- Needs analysis includes
  - What major muscle groups need to be trained?
  - What type of training should be used?
  - What energy system should be stressed?
  - What are the primary sites of concern for injury prevention?

RESISTANCE TRAINING PROGRAMME

Designing Resistance Training

- After analyzing the needs, the training is designed and advocated in terms of
  - Exercises to be performed
  - Order in which the exercises to be performed
  - Number of sets for each exercise
  - Rest period between sets and exercises
  - Intensity/load number of repetition, velocity of movement

Progressive Resistance Training

Selecting Appropriate Resistance/Repetitions

- Expressed as a percentage of athlete's 1RM
- Strength development is optimized by
  - Moderate to high resistance (60-80% of 1RM)
  - Low to moderate repetition (6-12 reps)
- Muscular endurance is optimized by
  - Low to moderate resistance (30-70% of 1RM)
  - Moderate to high repetitions (10-25 reps)

Progressive Resistance Training

Selecting Appropriate Resistance / Repetitions

- Power development is optimized by alternating
  - Low to moderate resistance and low repetitions (30-60% of 1RM and 6-12 reps) at an explosive velocity
  - Traditional strength training recommendations of moderate to high resistance and low to moderate repetitions (60-80% of 1RM and 6-12 reps)

Selecting appropriate number of Set

- Ideas of 1940s-1960s
  - At least 3 set of each exercise is needed to achieve greatest gains in muscle strength and size
- Ideas of 1990s onwards
  - Depends on the person who is being trained
  - Single set and multiple set studies were conducted
- Selecting proper set
  - Substantially reduces the total work out time
  - Inclusion of greater variety of exercises
- Even one set is appropriate for untrained people

Periodization of Training

Proper Periodization

- Varies the exercise stimulus
- Prevent overtraining and detraining
- Consist of two forms
  - Classic strength and power periodization
  - Undulating periodization
- May vary in duration from 1 cycle to 2-3 cycles/yr

Classic Strength and Power Periodization

- Five phases in each training cycle
- First phase is characterized by high volume and low intensity
- During next three phases volume is decreased and intensity is increased
- These four phases are followed by an active recovery phase that comprises of
  - Light resistance training

    or
  - Some unrelated activity

Classic Strength and Power Periodization

- After completion of this 5 phase, next cycle of periodization starts
- These 5 phase emphasizes the development as follows:
  - Phase 1: Muscular hypertrophy
  - Phase 2: Strength
  - Phase 3: Power
  - Phase 4: Peak strength
  - Phase 5: Active recovery

Undulating Periodization

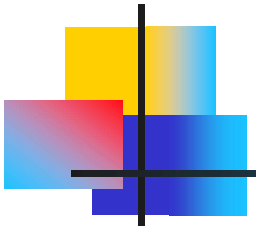
- Many ways similar to the classical approach
- Possesses considerable variations to meet the unique demands of each sports
  - Comprehensive details of this periodization plan is given in the text book:

    Designing Resistance Programme

    by

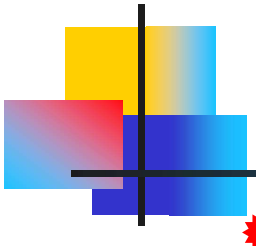
    Fleck and Kraemer

Interval Training



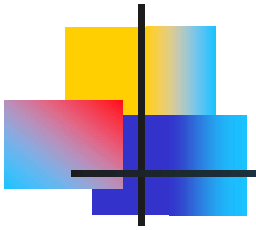
- Can be traced back from 1930s
- German Coach Woldemar Gercshler formalized a structured system of interval training for the first time (as available literatures)

Interval Training



- **Interval training consist of**
  - Repeated bouts of high to moderate intensity exercise interspersed with rest period or reduced intensity exercise
  - Terms, e.g., repetition, training time, training distance, training frequency, sets, exercise interval, rest or active recovery interval
  - Examples:
    - Set 1: 6×400m at 75s (90s slow jog)
    - Set 2: 6×800m at 180s (200s jog-walk)

Interval Training



- Primary variables that are manipulated to design an Interval Training for a specific sport
  - Rate of the exercise interval
  - Distance of the exercise interval
  - Number of repetition and sets
  - Duration of rest pause or active recovery interval
  - Types of activity of the active recovery interval
  - Frequency of training per week

Interval Training

Rate of Exercise Interval

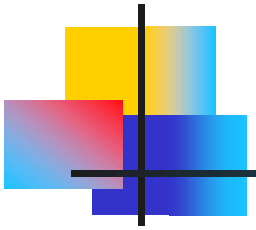
- Rate of exercise interval or intensity can be determined by
  - Establishing a specific duration for a set distance
  - Using a fixed percentage of the athletes HR max

Interval Training

Rate of Exercise Interval

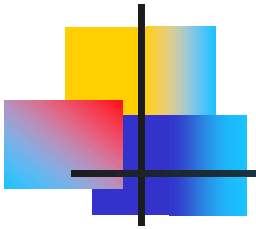
- For short sprints, setting specific duration is more practical
  - It is done by using the athlete's best time for set distance
  - The duration adjusted according to the athlete's target intensity, to develop
    - ATP-PC System, the intensity should be near maximum (i.e, 90-98%)
    - Anaerobic glycolytic system, intensity should be near maximum(i.e.,80-90%)
    - Aerobic system intensity should be moderated to high (i.e.,75-85%)

Training at a Percentage of HR



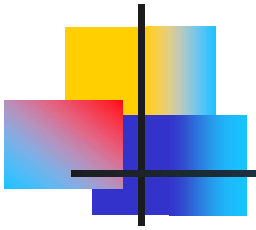
- HR max should be set at
  - (90-100)% to develop ATP-PC system
  - (85-100)% to develop anaerobic glycolytic system
  - (70-100)% to develop aerobic system

Distance of the Exercise Interval



- It is determine by the requirement of sports/event / activity
- Athletes involving sprint power events will utilize shorter sprinter of small intervals 30-200m
- A 200m sprinter runs over distances of 300-400m
- A 1500m runner will run
  - Short sprints of about 200m to develop speed
  - ≥1500m to develop endurance capacity as well as to combat fatigue.

Number of Repetitions and Sets during Each Training Session



- Largely determine by the needs of the sports / event / activity
- Shorter and more intense the interval, greater will be the repetitions and sets

Duration of the Rest / Active Recovery Interval

- Depends on the recovery capacity of the athletes
- It is best determined by the recovery HR
- For athletes of ≥30 yrs of age, the HR is allowed to drop to 130-150bpm, before starting the next set of exercise
- For athletes >30yrs of age, the allowed HR drops is between the values calculated formula following

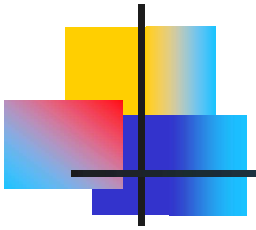
  [130-(Age of athlete-30)]bpm

  [150-(Age of athlete-30)]bpm
- Active recovery interval is also determined in similar fashion, but HR should be below 120bpm

Types of Activity during Active Recovery

- More intense the exercise interval, lighter or less intense the activity performed at active recovery
- For land based training it can very from slow walking to rapid walking or jogging
- In the pool, slow swimming with alternative stroke

Types of Resistance Training



1. Static-contraction resistance training
2. Free weights
3. Eccentric training
4. Variable resistance training
5. Isokinetic training
6. Plyometrics
7. Electrical stimulation training

Types of Resistance Training

A. Static Contraction Resistance training

- Also called isometric training
- Evolved in early 20th century and gained immense popularity during mid-1950s
- Results in tremendous gain in strength
- Significantly facilitates the post surgical rehabilitation
- Facilitate recovery and reduces muscle atrophy and strength loss.

B. Free Weight

- Variation in strength relative to the angle of movement
- More motor units are recruited exercising muscle as well as from the supporting muscles

B. Free Weight

- Variation in strength relative to the angle of movement
- More motor units are recruited exercising muscle as well as from the supporting muscles

C. Eccentric Training

- One type of dynamic contraction resistance training
- Muscle resist considerably greater force than with concentric contractions
- Produce greater strength gains
- Hypertrophies muscle

D. Variable Resistance Training

- Resistance is decreased at the weakest point of ROM and increased at the strongest point
- Underlying theory:
  - Muscle can be more fully trained if it is forced to act at higher constant percentages of its capacity through out each point in its range of movement

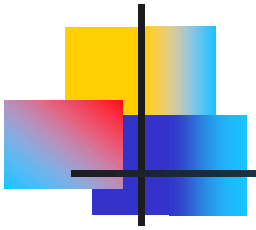
E. Isokinetic Training

- Light force or all out force is applied keeping the speed constant
- The individual is motivated to contract the muscles at maximum force at all points in the range of motion

F. Plyometrics

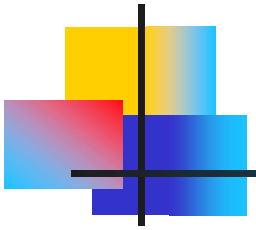
- Primarily advocated to improve jumping ability
- Bridge the gap between speed and strength training
- Improves stretch reflex to facilitate recruitment of more motor units
- Store energy in the elastic and contractile components of muscle during eccentric contraction that can be recovered during concentric contraction

G. Electrical Stimulation Training



- Proven effective in clinical setting to reduce loss of muscle strength and size during rehabilitations
- This training technique is used to supplement regular training programme during immobilization
- No additional gain is reported than those achieved with conventional training programmes.

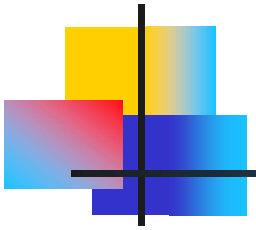
Resistance Training For Children



- Considerably little knowledge about the health benefits and risk of resistance training in pre-adolescents

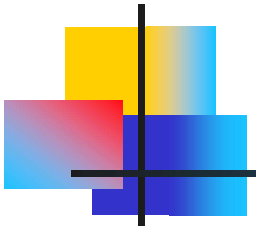
- Supervised resistance training using concentric only muscle actions with relatively high repetitions and low resistance improves muscular strength of children and adolescents without adverse effect on bones, muscles or connective tissue

Anaerobic & Aerobic Power Training Programme



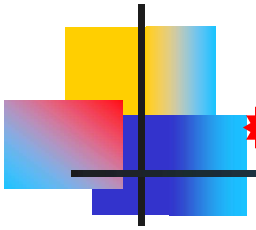
- Anaerobic & aerobic training programmes are quite different at the extremes but they are designed along a continuum
- These trainings are designed with major emphasis on the energy source(s) involved
- Different types programmes can be designed for specific requirement of each event
  - Interval training
  - Continuous training
  - Interval circuit

Frequency of Training Per Week



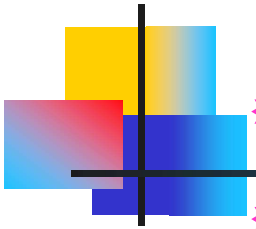
- Depends largely on the purpose of the interval training
- Top class runners need works 5-7 days/week
- For team sports athletes, the frequency will be around 2-4 days/week
- For various types of sports, application of Interval Training is well referred in Fox & Mathews (1974)

Continuous Training



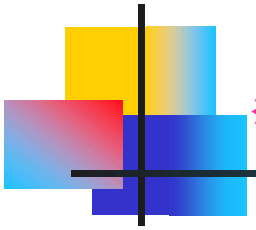
- This training involves continuous activity without rest intervals.
- Varies from long slow distance(LSD) training to high intensity training.
- This training is mainly to effect the
  - Oxidative energy system
  - Glycolytic energy system
- High intensity continuous training is performed at 85-95% of HR_{max}
- The training pace should be match or exceed the athlete's lactate threshold.

Long Slow Distance(LSD) Training



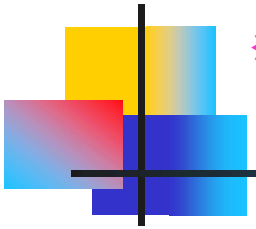
- Introduced by Dr. Ernst Van Auken(1920s)
- Athletes trains at (60-80)% of HR max ≅(50-75)% of VO_{2max}
- Distance rather than speed is the main objective
- Distance runners train 15-30 miles/day
- The pace of the run is slower than runners maximal pace
- Leas chance injury and hence safe for the nonathlete who perform training only for the health related purposes

Fartlek Training / Speed play



- Another process of continuous training developed in Sweden in 1930s
- Primarily used by distance runner
- It is a free form of training where fun is the goal
- Athletes trains himself/herself from high speed to jogging speed at his or her own discretion
- Many athletes perform this for fartlek training at country side where there are a variety of hills.

Interval Circuit Training



- Introduced in Scandinavian countries in 1960s
- Combines Interval Training and Circuit Training into one workout
- The distance varies from 3000m-10000m
- There are intermediate stations
- Athletes jogs, runs or sprints the distance between stations
  - Stop at each station to perform strength, flexibility or muscular endurance exercise
  - After that starts jogging, running or sprinting to the next station