

# Training methods (Continuous, Fartlek and Interval

Ph.D. Course Work (Physical Education)

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# ENDURANCE

**Endurance** -It is the ability to do sports movements with desired quality and speed under condition of fatigue.

1. It is a conditional ability and determined by energy liberation process
2. It is the product of psychic and physical organs and systems

## Types of endurance

1. **Classification according to nature of activity**
  - a) **Basic endurance** – ability of the organism to resist against fatigue in case of endurance loads of medium intensity of stimulus and mainly aerobic (muscular metabolism). It is also called aerobic endurance.
  - b) **General endurance** – ability to do sports movement of general nature with high or low intensity under condition of fatigue (aerobic and anaerobic metabolism).
  - c) **Specific endurance** – ability to do sports movements of a particular sport under condition of fatigue (aerobic or anaerobic or combination).

## 2. Classification according to duration of activity

1. Speed endurance – ability of the organism to resist against fatigue in case of endurance loads of sub – maximum intensity of stimulus and mainly anaerobic gaining of energy (alactacid metabolism) and maximum loss of oxygen.
2. Sprint endurance – ability of the organism to resist against fatigue in case of endurance loads of maximum intensity of stimulus and maximum motor frequency.
3. Short time endurance – this ability is required for cyclic activities which last from 45 seconds to 2 minutes. Energy is produced by combination of Glycolysis and oxidation. As a result, high amount of lactic acid concentration in blood and muscles. Example 400m, 800m
4. Medium time endurance - this ability is required for cyclic activities which last from 2 to 8 minutes. Energy is produced by combination of Glycolysis and oxidation. As a result, high amount of lactic acid concentration in blood and muscles. Example 1500m , 3000m
5. Long-time endurance – this ability is essential for all games and sports and activities continuing for more than 8 minutes. It can be divided into three types
  - a) Type I (11 – 30 minutes) – significant amount of energy production is achieved through Glycolysis and rest from Glycogen stores in muscle and liver. High amount of lactate concentration found in blood and muscles.
  - b) Type II (30 - 90 minutes) – high amount of energy production is achieved through oxidation (high carbohydrate metabolism and significant fatty acids metabolism). Low lactate concentration found in blood and muscles.
  - c) Type III (30 minutes >) – high amount of energy production is achieved through oxidation of fatty acids metabolism and carbohydrate metabolism. Very low lactate concentration found in blood and muscles.

## Factors Determining Endurance: Aerobic and Anaerobic Capacity

### :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<sub>2</sub> max).

### Factors determining The aerobic capacity (VO<sub>2</sub> max)

**a) Oxygen Intake: Amount of oxygen that can be extracted by the blood from the atmosphere. It depends on**

1. *Vital capacity*
2. *Lung size*
3. *Number of active lung alveoli*
4. *Strength of respiratory muscles*
5. *Size of chest cavity*

**b) Oxygen transport: Amount of oxygen that can be transported from the lungs to the working muscle.**

- The amount of oxygen which the blood has absorbed from lungs
- The cardio – circulatory system to carry this quickly to the muscles for consumption

**c) Oxygen uptake: Amount of oxygen taken up by the muscle cells from the blood.**

- Speed of blood flow
- Temperature and partial pressure of oxygen in blood
- Carbon dioxide in muscle cells

**d) Energy reserves: Amount of glycogen stores in the muscles and liver**

# Anaerobic Capacity

- **Meaning:** Anaerobic means “without oxygen” and it is the ability of the organism to perform an activity in the absence of oxygen.
- **Energy Production:** In the absence of oxygen the energy production for the muscle contractions can take place in two ways either from breakdown of phosphogen (ATP and CP) or from glycolysis of muscle glycogen.
- **Alactacid mechanism and alactacid mechanism:**
  - Through splitting of ATP and CP (Phosphogenes) :** The process of production of energy due to breakdown of ATP and CP is termed as alactacid mechanism as it does not lead to formation of lactic acid.
  - By glycolysis of muscle glycogen (i.e. carbohydrate) :** production of energy due to glycolysis of muscles glycogen is called lactacid mechanism as it results in the formation of lactic acid.

**Limited store:** 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

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## Anaerobic capacity depends upon the following factors:

- a) Phosphogen Stores:** Adenosine triphosphate and creative phosphate stores in the body
- b) Buffer Capacity:** Ability of the alkali reserves of the body to neutralize lactic acid.
- c) Lactic Acid Tolerance:** Ability of the individual to tolerate high concentration of lactic acid in the blood and muscles .
- d) Aerobic Capacity:** Amount of oxygen consumed by the working of muscles per minute ( $\text{VO}_2$  max).

Muscle cell energy systems can be summarised in the following table:

<i>Duration (secs)</i>	<i>Classification</i>	<i>Energy sources</i>
1-2	Anaerobic	Muscle ATP
2-10	Anaerobic	ATP+CP
10-45	Anaerobic	ATP+CP+glycogen
45-120	Anaerobic glycolytic	Glycogen/glucose
120-140	Aerobic + anaerobic	Glycogen/glucose+lactate
140+	Aerobic	Glycogen/glucose+fatty acids

[The duration times given are for maximum effort, are approximate and depend on the individual.]

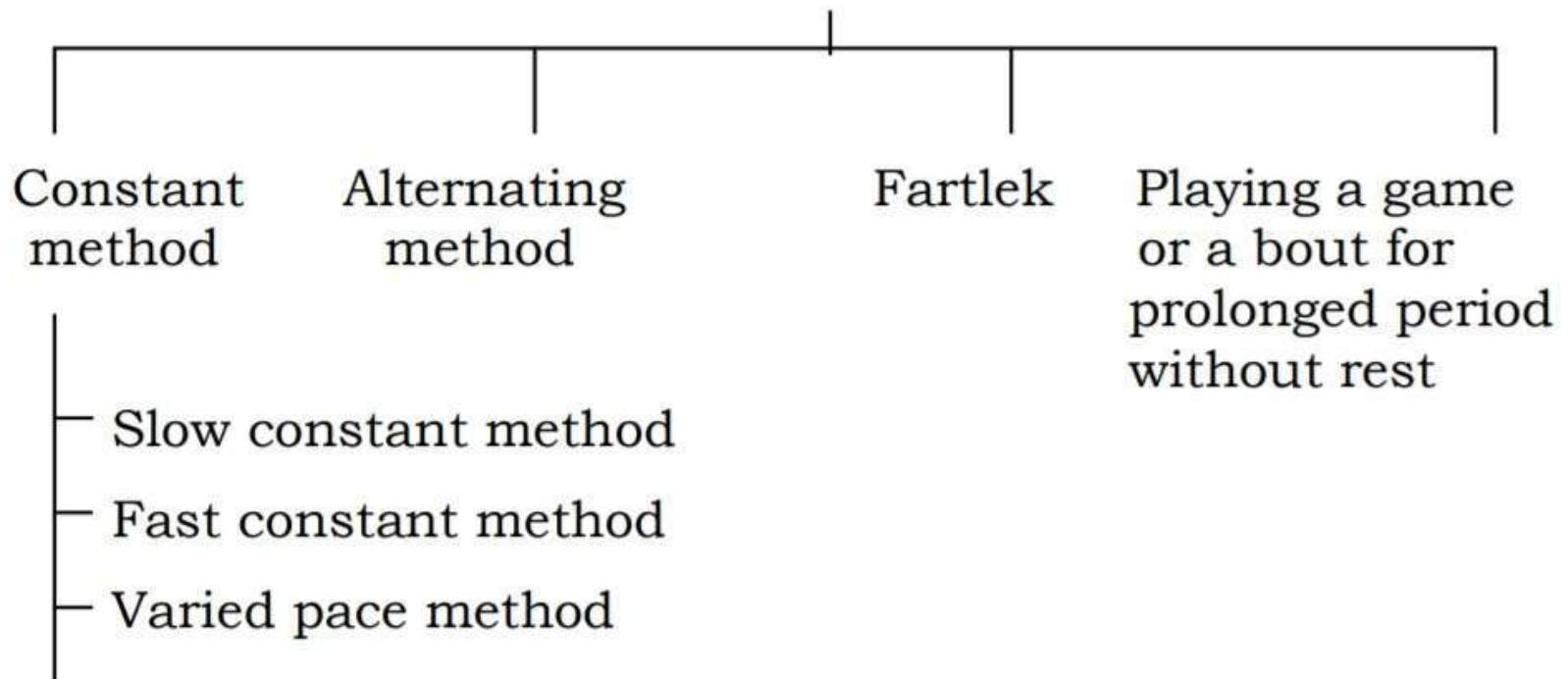
Event	% energy system contribution (approx)		
	Anaerobic		Aerobic
	alactic	lactic	
100m	70	22	8
200m	40	45	15
400m	10	60	30
800m	5	40	55
1500m	2	23	75
3000m	<1	12	88
5000m	<1	7	93
10000m	<1	3	97
1/2 marathon	<1	<1	99

# The following basic methods of conditioning have been discussed in this lecture:

1. Methods based on continuous principle

2. Methods based on interval principle

## Duration Load Methods





# 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:

## **Continuous method**

- 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

### 1. **Slow continuous method**

**Intensity:** 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.

**Volume of load:** 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.

## **2. Fast continuous method –**

**Intensity:** 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.

**Volume of load:** The volume of load in terms of duration should not be less than 20 minutes.

### **Advantages**

- This method is effective for enhancing VO<sub>2</sub> 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.

**Variable pace method –** This method also involves application of uninterrupted loads but with change of pace or spread.

**Intensity:** During this period of undertaking of load, the heart rate is maintained between 140 to 180 beats per minute

**Volume of load:** 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

This method is beneficial for improving both aerobic and anaerobic capacities

<b>Method</b>	<b>Physiological Effect</b>	<b>Training Effect</b>	<b>Psychological Effect</b>
Continuous Method	<ul style="list-style-type: none"> <li>• Improves efficiency of cardio respiratory system.</li> <li>• Development of aerobic capacity</li> <li>• Development of anaerobic capacity</li> <li>• Increased <math>VO_2</math>max</li> <li>• Increased muscle glycogen</li> <li>• Capillarisation</li> <li>• Improved</li> </ul>	<ul style="list-style-type: none"> <li>• Development of basic endurance</li> <li>• Development of strength endurance</li> </ul>	<ul style="list-style-type: none"> <li>• Improvement of determination and will power.</li> <li>• Enhancement of tolerance ability in respect of pain and discomfort.</li> </ul>

# Fartlek

- Fartlek is a Swedish term meaning “speed play”.
- This method was developed in Scandinavia to provide an alternative to continuous running.

**Mixture of slower and faster phases:** 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.**

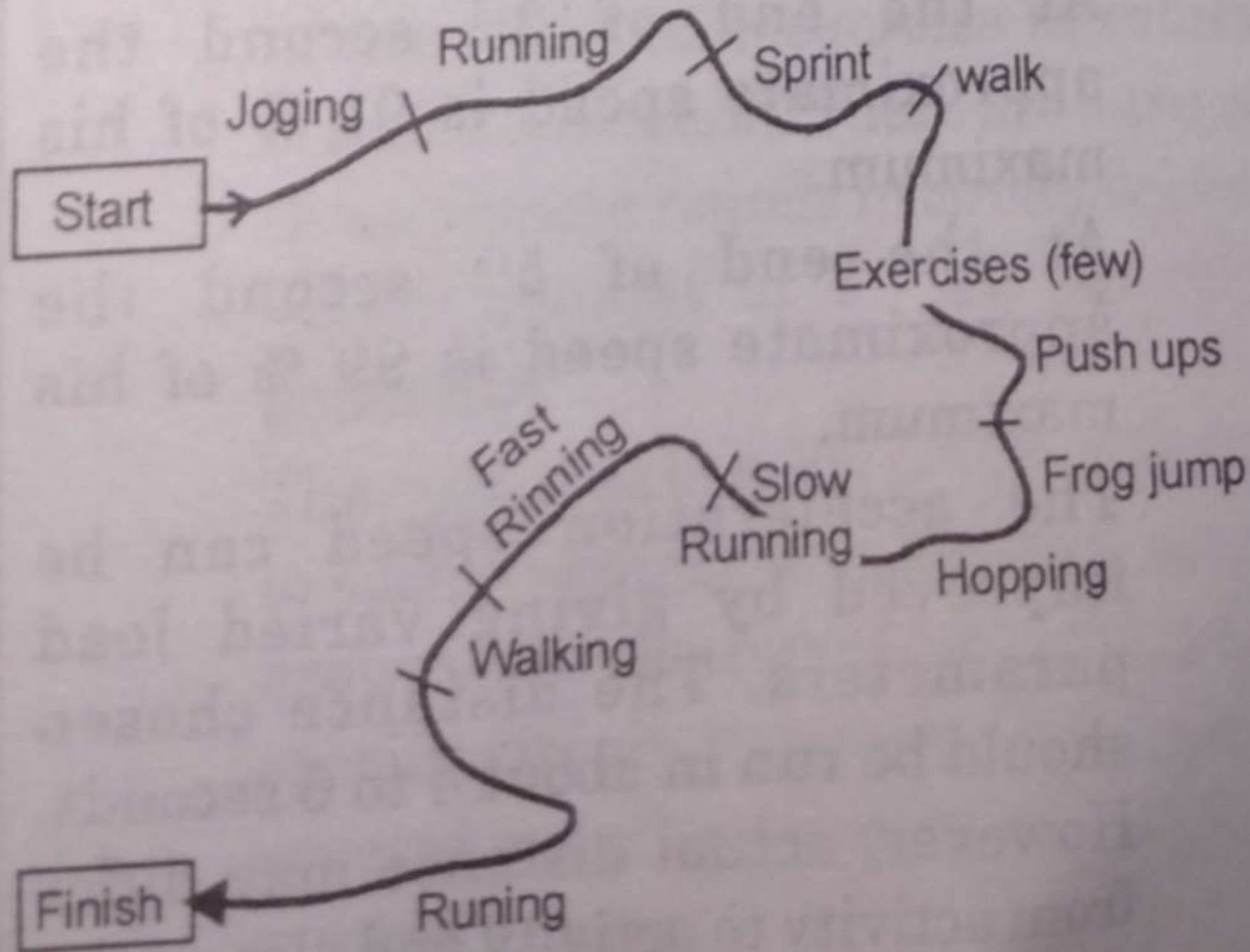
**The terrain selected was such that**

- **it involved running on different surfaces,**
- **running through the woods,**
- **running by the river**
- **or sea side,**
- **running up and down the hill**

**This method is effective for developing both aerobic and anaerobic capacities of sportspersons**

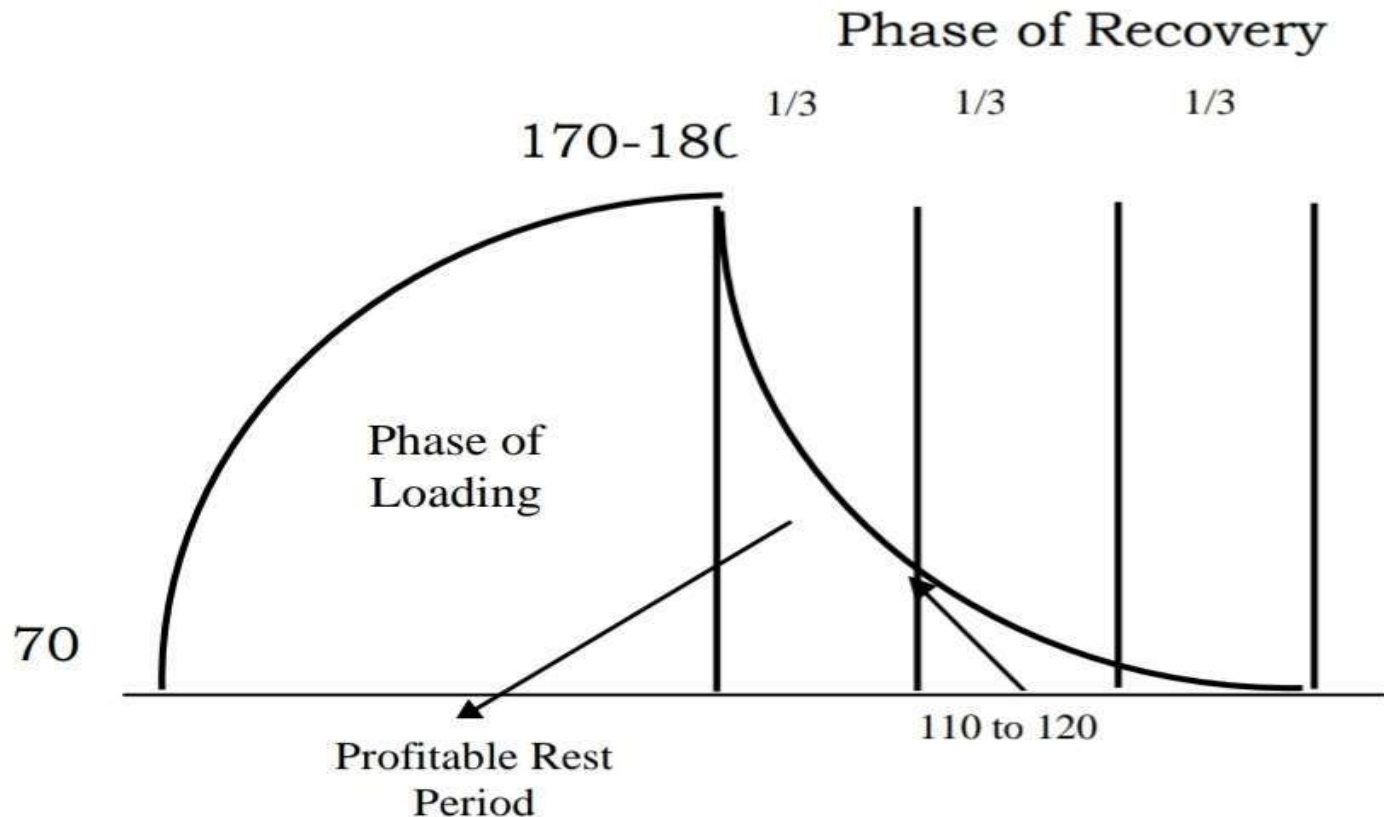
**An example of training schedule using Fartlek is as follows:**

- 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**



## Interval Method

- It is perhaps the most versatile method of endurance training, which involves repeated efforts 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



## Variation of interval method

- 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.

## Categorization of variation of interval method

The above three variations of interval method can be categorized into intensive interval method and extensive interval method.

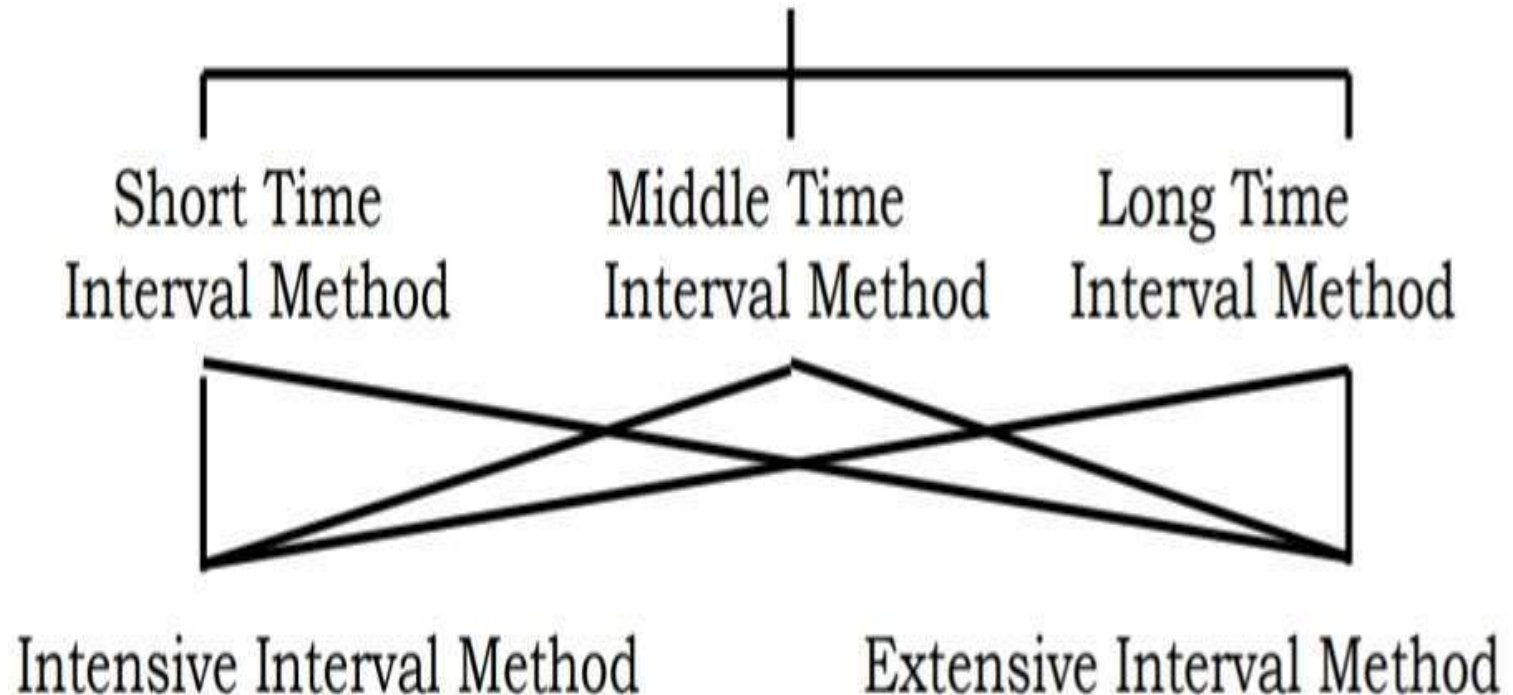
The intensive interval method is dominated by high intensity (80% to 90%).

The extensive interval method dominated by volume of stimulus and intensity is comparatively less (60% to 80%).



The interval method can be classified as follows:

## Interval Method



## 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

	Repetitions	Work interval		Relief time
		Training distance	Training time	
Set 1	One 220 yards run = 1 repetitions Hence, one 220 yards run will be repeated 6 times	220 yards	220 yards run in 33 seconds 33	There is 1 minute 39 seconds between each repetition
	6	220	0.33	1.39

## Recovery recommendation

- 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.

Sports where interval running recommended - recommended for improving specific endurance in cyclic sports

- ✓ track and field events,
- ✓ swimming events,
- ✓ cycling and the like.
- ✓ team games,
- ✓ combative sports
- ✓ racket sports.

## Effects of Interval Method

Method	Physiological Effect	Training Effect	Psychological Effect
Interval Method i) Intensive Method	<ul style="list-style-type: none"> <li>• Improves efficiency of cardio respiratory system.</li> <li>• Development of aerobic capacity</li> <li>• Development of anaerobic capacity</li> <li>• Increased VO<sub>2</sub>max</li> <li>• Increased muscle glycogen</li> <li>• Capillarization</li> <li>• Improved compensation capacity.</li> </ul>	<ul style="list-style-type: none"> <li>• Development of basic endurance</li> <li>• Development of strength endurance</li> <li>• Development of strength</li> </ul>	<ul style="list-style-type: none"> <li>• Improvement of determination and will power.</li> <li>• Enhancement of tolerance ability in respect of pain and discomfort.</li> <li>• Enhanced ability to work under fatigue conditions.</li> </ul>

ii) Extensive Method	<ul style="list-style-type: none"> <li>• Improves efficiency of cardio respiratory system.</li> <li>• Hypertrophy of heart</li> <li>• Hypertrophy of skeletal muscles</li> <li>• Development of aerobic capacity</li> <li>• Development of anaerobic capacity</li> <li>• Increased VO<sub>2</sub>max</li> <li>• Increased muscle glycogen</li> <li>• Capillarization</li> <li>• Improved compensation capacity</li> <li>• Increase ATP and CP reserves</li> </ul>	<ul style="list-style-type: none"> <li>• Development of speed and strength endurance.</li> <li>• Development of explosive strength</li> <li>• Development of maximum strength</li> </ul>	<ul style="list-style-type: none"> <li>• Improvement of determination and will power.</li> <li>• Enhancement of tolerance ability in respect of pain and discomfort.</li> <li>• Enhanced ability to work under fatigue conditions.</li> </ul>
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**THANK YOU**