

# UNIT-I : PLANNING IN SPORTS

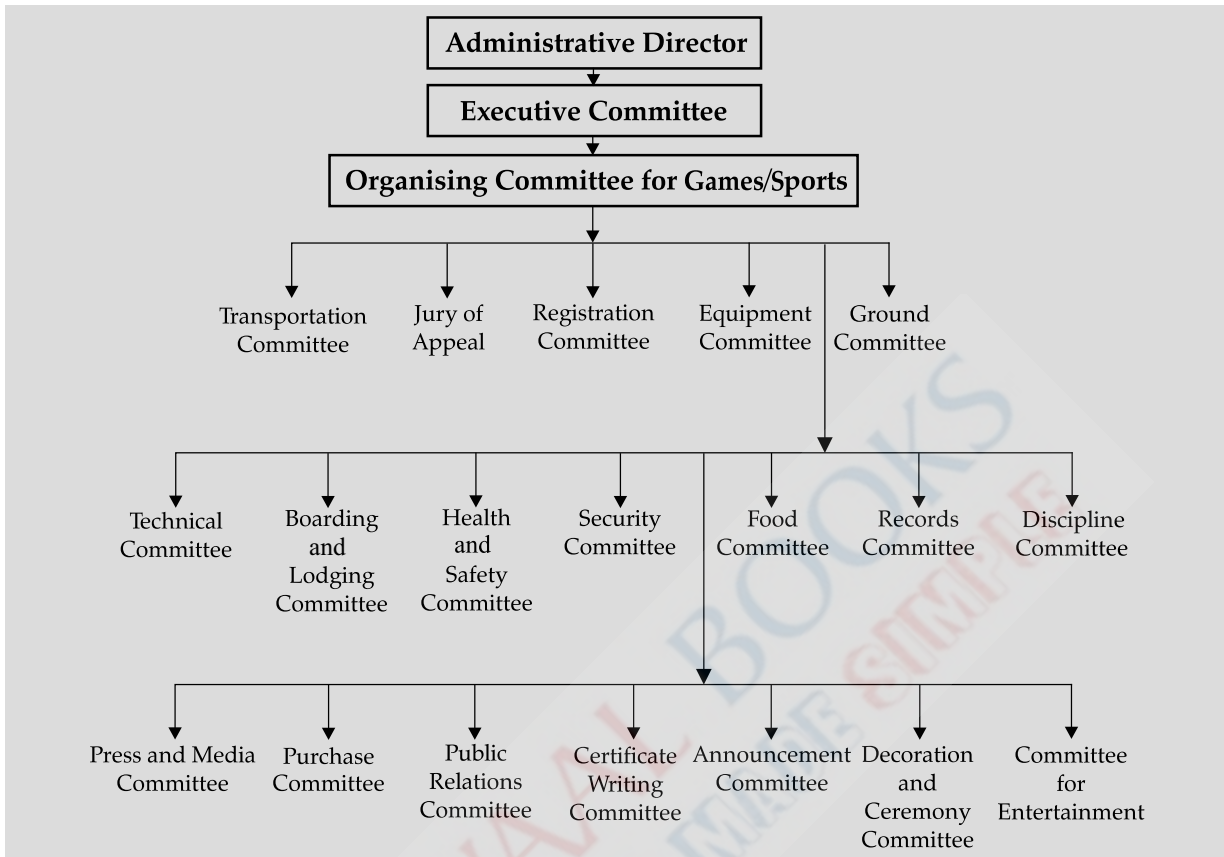
## CHAPTER-1 PLANNING IN SPORTS

### Meaning and Objectives of Planning and Various Committees

#### Revision Notes

- "Planning is a process of setting objectives and deciding how to accomplish them".  
**Objectives of Planning are**
  - (i) Improving the success rate
  - (ii) Completing the task within the given time period
  - (iii) Finding out causes of failure
  - (iv) Working efficiently
  - (v) Remaining within the budgets while achieving the pre-determined targets.
- **Functions of Management**
  - (a) **Planning:** Planning is the process of achieving pre-determined goals and decide what is to be done, how it is to be done. When it is to be done and by whom it is to be done.
  - (b) **Organising:** Organising is the management function of assigning duties, grouping tasks, establishing authority and allocating resources to carry out a specific plan.
  - (c) **Staffing:** This function is concerned with finding the right person for the right position at the right time.
  - (d) **Directing:** Directing is the process of supervising, motivation, Leading and communicating with the subordinates to achieve the organisational objectives.
  - (e) **Controlling:** The task of controlling involves establishing standards of performance, measuring current performance, comparing it with established standards and taking corrective actions, if there is any significant deviation between actual and planned performance.
- **Objectives of Planning**
  - (a) **To reduce the chances of mistakes:** It is also a important objectives of planning. Mistakes and oversight in any field cannot be avoided completely but we can reduced up to some extent through proper planning.
  - (b) **To enhance the risk bearing capacity:** It is also an important objective of planning. RBC can be used in the process of defining the risk appetite and tolerance to the mistakes and financial impacts.
  - (c) **To enhance the sports performance:** Without proper planning it is impossible to improve the performance of sports person.
  - (d) **Goal oriented:** Planning is goal-oriented process. It aims at conducting sports events. No plan can be implemented in absence of a goal. Before defining an objective for a sports event, the organising committee must have full knowledge of the event and its various aspects.
  - (e) **Policy:** Defining a policy sets out the boundaries for overall conduct of the event. It serves as a guide and helps in all decision-making process related to the sports event.
  - (f) **Economy:** Planning helps in foreseeing future events and thereby help in cost reduction. A clearly defined budget defines the financial limits of the sports events.
  - (g) **Defining the course of action:** A well-laid procedure identifies the steps that need to be taken to accomplish a task. It helps in standardizing the work of committees, heads or individuals.
  - (h) **Rules and regulations:** Rules and regulations of tournament or sports events are determined and circulated in advance to reduce the chances of biasness and malpractices.
  - (i) **Strategy:** It provides the way through which an organisation can successfully conduct the event. The organising committee must devise a strategic plan and thoroughly follow the same.
- Various committees are formed to plan and successfully implement the plans like, to organise a tournament. There are different committees which are formed and each of them are assigned with a different task.

### Various Sports Committees and their Responsibilities



#### ➤ Some important committees and their responsibilities

- **Press and Media Committee** : Its main duty is to publish and advertise the sports events.
  - **Transportation Committee** : Its main responsibility is to make necessary arrangements for transportation.
  - **Equipment Committee** : This committee is responsible for making the grounds or laying out the track and field.
  - **Committee for Entertainment** : This committee takes the charge of supplying refreshments and drinks to the guests, officials, competitors, etc.
  - **Decoration and Ceremonies Committee** : The members of this committee are responsible to welcome the chief guests at the opening and closing ceremonies.
  - **Registration Committee** : This committee sends entry forms to the various institutions early. It also arranges seats for guests and spectators. It sometimes also prepares fixtures of teams participating in the competition.
  - **Technical Committee** : This committee selects various officials such as referees, judges, umpires, etc.
  - **Announcement Committee** : This committee is responsible for making all the announcements during the period of sports events.
  - **Health and Safety Committee** : This committee provides first aid to the victim or affected sportsman/athlete.
- For successful organisation of the sports meet, committees are formed under three heads These are Pre-meet committees like publicity, ground and equipment, reception committee During meet committees like refreshment, transport committee and Post-meet committees like award committee.

## Tournaments and Fixtures

### Revision Notes

- **Tournament** is a competition held among various teams in a particular activity according to a fixed schedule where we have to decide a winner.
- There are various methods for organising a tournament which depends upon various factors such as

- The number of participating teams
- Facilities of ground
- Equipment and number of officials available
- Days in which the tournament is to be completed
- **Importance of Tournaments**
  - Development of sports skills
  - Helpful in selection of players
  - Development of national and international integration
  - Development of social qualities such as respect, brotherhood, discipline, sympathy, tolerance, etc.
- **Seeding** is the procedure by which good teams are placed in fixtures in such a way that stronger teams do not meet each other at very start of the tournament. Seeding can be done only if the standards of the teams are known before the tournament starts.
- Bye is a privilege given to a team which is decided generally by seeding it or by draw of lots.
- **Types of Tournaments**
  - Knock-out or Elimination tournament
  - League or Round Robin tournament
  - Combination tournament
  - Challenge tournament
- **Knock-out or Elimination Tournament** : It is a type of elimination tournament where the loser of each bracket is immediately eliminated from the tournament. In such tournaments, if the number of competitors or competing teams are not a multiple of 2 (i.e. 4, 8, 16,..) then some teams may be given a 'bye' and some teams are given 'seeding'.
  - **Advantages**
    - Minimum number of officials are required in organizing tournaments.
    - Owing to lesser number of matches, it takes less time to complete the tournaments.
    - It helps in enhancing the standard of sports.
  - **Disadvantages**
    - Good teams can get eliminated because of their poor performance even in the first round.
    - There are maximum chances of weak teams to enter into the final round.
- **League or Round Robin Tournaments** : A league tournament is a type of tournament in which each contestant meets all other contestants in turn. In this type of tournament, there has to be sufficient time to complete the tournament.
  - **Types:**
    - **Single league** : In a single league round robin schedule, each participant plays with every other participant once. Number of matches played is equal to  $\frac{N(N-1)}{2}$ , where N is the number of teams.
    - **Double league** : If each participant plays with others twice, this is called a round robin double league tournament. Number of matches played is equal to  $N(N-1)$ , where N is the number of teams.
- **Fixture** : Every tournament is arranged according to a set procedure which is known as fixture.
  - For knock-out tournament, the procedure to draw fixture is through bye and seeding. For league tournaments, the procedure to draw fixture is through staircase and cyclic method.
  - The success of a tournament depends upon planning of suitable fixture.
  - Tournaments are played in various forms of fixtures.
- **Fixtures in Knock-out Tournament**
  - **Seeding Method** : Seeding is a procedure by which good teams are placed in fixtures in such a way that stronger teams do not meet each other at the very start of a tournament. It is done to overcome the drawbacks of a single knockout tournament.
    - Seeding can be done only if the standards of the teams are known before the start of the tournament.
    - The draw may result between the strong competitors at early level competition, so they are 'seeded' to prevent this.
    - The top competitors do not meet until the quarter-final, semi-final or final round.
    - It represents the tournament committee's subjective rating of the various players, and chances of winning the tournament.
  - **Special Seeding** : It is a method of seeding in which the players or teams directly participate in the quarter-final or semi-final matches thus avoiding their participation in the initial rounds.
  - **Bye Method** : Some teams may get bye in first round, by which they get promoted to Next round competition. This may be given as a reward for their some previous achievements.
    - Byes are given in 1st round only.
    - The number of byes that should be given in a tournament is decided by finding the difference between the number of teams and the next power of two.

➤ **Method of Drawing Fixtures in Knock-out Tournament**

- Calculate Total number of matches that will be played during the entire tournament. The number of matches to be played is calculated by subtracting 1 from total number of teams ( $N - 1$ ).
- Calculate Number of Rounds – Rounds include the initial rounds, quarter-finals, semi-finals and finals. If the number of teams is a power of 2, then number of rounds will exactly be multiple of 2 up to that number.

Example : In case of 8 teams, there are  $2^3$  teams, so, number of rounds will be 3.

If number of teams is not a power of 2, then number of rounds will be equal to the multiple of next power of two.

**Example :** In case of 14 teams, there are  $(2^3+6)$  teams, so, number of rounds will be 4.

- Calculate Number of teams in each half – All the teams are divided into two halves. If the number of teams is even, then the number of teams in upper and lower half will be equal.

**Example:** In case of 12 teams, number of teams in each half will be

$$\frac{N}{2} = \frac{12}{2} = 6$$

If the number of teams is odd, then the number of teams in upper and lower half will be as under:

**Example:** In case of 15 teams, number of teams in upper half will be

$$\frac{N+1}{2} = \frac{15+1}{2} = \frac{16}{2} = 8$$

and, number of teams in lower half will be

$$\frac{N-1}{2} = \frac{15-1}{2} = \frac{14}{2} = 7$$

- **Calculate Number of byes :** Teams getting the byes do not play in the initial round. They are given by subtracting the number of teams by the next power of 2.

**Example:**

Total number of teams = 11

Next power of two after 11 = 16 ( $2^1 = 2, 2^2 = 4, 2^3 = 8, 2^4 = 16$ )

Number of byes will be  $16 - 11 = 5$

- Calculate Number of byes in upper and lower half

$$\text{Number of byes in upper half} = \frac{Nb-1}{2} = \frac{5-1}{2} = \frac{4}{2} = 2$$

$$\text{Number of byes in lower half} = \frac{Nb+1}{2} = \frac{5+1}{2} = \frac{6}{2} = 3$$

- **Method of fixing byes**

- The last team of lower half gets first bye.
- The first team of upper half gets second bye.
- The first team of lower half gets third bye.
- The last team of upper half gets fourth bye.
- The second last team of lower half gets fifth bye.
- Like this the order continues.

➤ **Fixtures in League Tournaments**

- **Staircase method :** In this method, the fixtures are made like a staircase. It is arranged in sequential form, there is no bye, no problem of odd or even and therefore it is easiest to arrange.

1-2										
1-3	2-3									
1-4	2-4	3-4								
1-5	2-5	3-5	4-5							
1-6	2-6	3-6	4-6	5-6						
1-7	2-7	3-7	4-7	5-7	6-7					
1-8	2-8	3-8	4-8	5-8	6-8	7-8				
1-9	2-9	3-9	4-9	5-9	6-9	7-9	8-9			
1-10	2-10	3-10	4-10	5-10	6-10	7-10	8-10	9-10		
1-11	2-11	3-11	4-11	5-11	6-11	7-11	8-11	9-11	10-11	
1-12	2-12	3-12	4-12	5-12	6-12	7-12	8-12	9-12	10-12	11-12

- **Cyclic method**

I round	II round	III round	IV round	V round	VI round
9 B	8 B	7 B	6 B	5 B	4 B
8 1	7 9	6 8	5 7	4 6	3 5
7 2	6 1	5 9	4 8	3 7	2 6
6 3	5 2	4 1	3 9	2 8	1 7
5 4	4 3	3 2	2 1	1 9	9 8
VII round	VIII round	IX round			
3 B	2 B	1 B			
2 4	1 3	9 2			
1 5	9 4	8 3			
9 6	8 5	7 4			
8 7	7 6	6 5			

## UNIT-I : SPORTS AND NUTRITION

### CHAPTER-2

## SPORTS AND NUTRITION

### Balanced Diet and Nutritive Components

#### Revision Notes

- **Nutrition** : Nutrition is defined as the science of food and its relationship to health. In other words, it can be said that nutrition is the science of food which deals with the dynamic process in which the consumed food is digested.
- **Nutrients** : Essential substances present in the food. e.g Carbohydrate, protein, fat, vitamins & minerals.
- **Diet** : Contains variety of foodstuffs. This helps in protecting us from diseases and in the repair of worn out tissues and gives energy.
- **Balanced Diet** : A diet that contains right amount of carbohydrates, proteins, fats, minerals, salts, vitamins, roughage and water is called a balanced diet.
- The various components of Balanced Diet are:
  - **Cereals and Millets**: These include wheat, rice, jowar, bajra, ragi etc. These are sources of Carbohydrates, Proteins, Vitamin B - Complex, Iron and Calcium.
  - **Pulses**: These include red gram (lobia), Bengal gram (chana), lentils, green gram (moong) etc. These are sources of proteins, Carbohydrates, Vitamin B-Complex, Vitamin C and Iron.
  - **Milk and Milk Products**: These include milk, curd, cheese, paneer, khoya, etc. These are sources of Proteins, Carbohydrates, Fat, Calcium and Vitamin B-2.
  - **Meat and Meat Products**: These include meat, fish, chicken, egg and products made with these. These are sources of Proteins, Vitamin B -Complex and Calcium
  - **Nuts and Oil Seeds**: These include ground nuts, almonds, cashew nuts, til seeds, pistachio etc. These are sources of Proteins, Vitamin B-Complex, Calcium, etc.
  - **Green Leafy Vegetables (GLVs)**: These include mustard (sarson), bathua, fenugreek (methi), spinach (palak). These are good sources of Vitamin A, Vitamin B-Complex, Vitamin C, Iron and Fibre.



- **Root Vegetables:** These include potato, colocasia, sweet potato, yam, etc. These are rich sources of Carbohydrates.
- **Other Vegetables:** All other vegetables like brinjal, ladyfinger, beans, cauliflower, etc. provide fibre, vitamins, some amount of minerals.
- **Fruits:** Fruits are sources of different nutrients. So, a combination of different fruits must form part of the balanced diet so as to cover all essential nutrients.

➤ **Roughage :** The fibre present in the food which helps to eliminate wastes from the body.

➤ **Elements of Diet :** A diet which contains all the food stuffs necessary to maintain good health consists of following elements :

- |                   |               |            |
|-------------------|---------------|------------|
| (i) Carbohydrates | (ii) Proteins | (iii) Fats |
| (iv) Minerals     | (v) Vitamins  | (vi) Water |

(i) **Carbohydrates :** Carbohydrates gives us energy to work. Sugar and starch are carbohydrates. Potato, rice, bread, banana and grapes are rich sources of carbohydrates. These are called energy giving foods. Simple and complex are two types of carbohydrate.

• **Carbohydrates are of three types:**

■ **Monosaccharides :** These refer to simple sugars like glucose, fructose and galactose.

■ **Disaccharide :** These refer to sugar units which are formed when two monosaccharides combine together. These generally consist of maltose, lactose and sucrose.

■ **Polysaccharide :** These refer to carbohydrate units which are formed when more than two units of monosaccharides combine together. These generally consist of starch, fibre and cellulose.

(ii) **Proteins :** Proteins are nutrients that help to build the body and make new cells. They help us in the repair of worn-out tissues. They are especially important for growing children. They are called body building food. Milk, eggs, cheese, pulses, meat and fish are rich in proteins. Some essential proteins or amino acids are Histidine, Isoleucine, Leucine, Lysine, Methionine, Phenylalanine, Threonine, Tryptophan and Valine. Some non-essential proteins or amino acids are Alanine, Arginine, Asparagine, Aspartate, Cysteine, Glutamate, Glutamine, Proline, Serine and Tyrosine.

(iii) **Fats:** Fats provide us with twice as much energy as carbohydrates. We can store extra fat in our body which can be used later. Butter, ghee and nuts are rich sources of fats, but too much of fats can lead to diseases like high blood pressure, heart problem and obesity.

• **Fatty acids are the building blocks of fats and oils. Fatty acids can be categorised as:**

■ **Saturated fatty acids (SFA) :** These fatty acids do not contain double bonds. These fats are called as animal fats. These fats gave increased health risks. Overconsumption of these fats increases the risk of heart related issues and it results in increased cholesterol levels.

■ **Unsaturated fatty acids (UFA) :** The consumption of these fatty acids results in lowering the cholesterol levels in blood. As a result, there is a reduction in risk of heart-related complications. These are further classified into:

\* Monounsaturated fatty acids (MUFA) contain one double bond

\* Polyunsaturated fatty acids (PUFA) contain more than one double bond.

(iv) **Minerals :** Minerals are also needed in a very small quantity to keep us fit and healthy. These are called protective foods.

• Some important minerals are:

(a) **Iron :** It is important for the formation of haemoglobin. Its deficiency leads to anaemia and sources are meat, eggs and dry fruits.

(b) **Calcium :** It is needed for the formation of strong bones, teeth and also for clotting of blood and muscle contraction. Its deficiency causes rickets, asthma and sources are milk, egg yolk, cheese and orange.

(c) **Phosphorus :** It is required for development of strong bones and teeth and also for making energy. Its sources are egg, fish, meat and unpolished rice.

(d) **Potassium :** It is important for growth and keeping cells and blood healthy. Its deficiency weakens the muscles of the body and sources are carrot, beet root, onion, tomato, orange and mango.

(e) **Sodium :** It is needed for the proper functioning of the nervous system. Its sources are milk and milk products, meat and eggs.

(f) **Iodine :** It is essential for proper thyroid function. Its deficiency causes goitre and sources are sea-food and salt.

(g) **Fluorine :** It is important to make the enamel (polish) of the teeth hard and prevents dental decays.

(h) **Copper :** It is helpful in formation of red blood cells, connective tissue and nerve fibre formation and functioning.

(i) **Zinc :** It is required for insulin production and also for functioning of male prostate, digestion and metabolism.

- (j) **Magnesium**: It is required for development of immune system and nerve transmission.
- (k) **Sulphur**: It is required for formation of proteins in the body.
- (v) **Vitamins**: Vitamins are needed by our body in a very small quantity. They keep us healthy by helping the body to fight against the diseases. They also help our eyes, nerves, gums, skin, etc., to work properly.
- Vitamins consist of two groups- fat soluble and water soluble groups.
- (a) **Vitamin 'A'**: Keeps eyes and skin healthy.
- (b) **Vitamin B1 (Thiamine)**: Helps to release energy from foods, promotes normal appetite and is important in maintaining proper nervous system function.
- (c) **Vitamin B2 (Riboflavin)**: Helps to release energy from foods, promotes good vision and healthy skin, helps to convert the amino acid tryptophan into niacin.
- (d) **Vitamin B3 (Niacin)**: Metabolises food and provides energy for the body, involved in energy production, normal enzyme function, digestion, promoting normal appetite, healthy skin and nerves.
- (e) **Vitamin B6 (Pyridoxine)**: Key factor in protein and glucose metabolism as well as in the formation of haemoglobin.
- (f) **Vitamin B12 (Cobalamin)**: Aids in the building of genetic material, production of normal red blood cells and maintenance of the nervous system.
- (g) **Vitamin 'C'**: Makes gums strong and heals our wounds faster.
- (h) **Vitamin 'D'**: Makes teeth and bones strong.
- (vi) **Water**: Almost two-third of our body is made up of water. Water helps our body to work well and maintain our body temperature. We need to drink at least 10-12 glasses or approx, 6-7 litres of water every day.
- **Components of Diet:**
- **Nutritive components of diet**: Food contains a variety of nutritional components that can be categorised as macro-nutrients and micro-nutrients. Macro-nutrients are nutrients needed in large quantities that provide calories or energy for growth, metabolism and other functions in our body. These include carbohydrates, fats, and proteins. Micro-nutrients, such as vitamins, minerals and antioxidants are involved with cellular and chemical processes in our body and are needed in small quantities.
- **Non-Nutritive components of diet**: Food contains some components that are not classified with the basic nutrient groups. All sorts of substances can be found in food-natural, intentional and unintentional. Non-nutritive components of diet mean, components which do not add or supply energy or calories. Non-nutritive components of diet are discussed below:
- (a) **Colour components**: Food is made more appetizing and interesting by the wide spectrum of colours made possible through pigments. Most natural pigments are found in fruits and vegetables, the colours of food from animal products and grains are less varied and bright. The dominant pigment found in plants are carotenoid (orange, yellow and red), chlorophyll (green) and flavonoid (blue, cream and red).
- (b) **Flavour components**: The flavour in foods are derived from both nutrient and non-nutrient components. These are sometimes too numerous to track as the source of a specific flavour. Among the non-nutrient components in foods are the organic acids that determine whether foods are acidic or basic. An acidic pH in foods not only contributes to a sour taste, but the colour of fruit juices, the hue of chocolate in baked products, and the release of carbon dioxide in a flour mixture. An alkaline pH contributes a bitter taste.
- (c) **Plant components**: In addition to colour and flavour components, some plants contain other non-nutritive substances that, when ingested, may have either beneficial or normal effects. Many of the possible anti-carcinogens, or compounds that inhibit cancer, come from plants. In particular, phytochemical, called indoles is found in vegetables, which is found in plants. The vegetables like cabbage, cauliflower, kale, mustard greens and collards have this. Laboratory animals which were given in doles and then exposed to carcinogens developed fewer tumors than animals exposed to some carcinogens, but not given in doles.
- **Non-Nutritive Factors or Anti-Nutritional Factors (ANFs)** interfere with absorption of nutrients by the body. Some ANFs are:
- **Phytates**: These are found in unrefined cereals and millets. These phytates bind iron, zinc, calcium and magnesium and make these nutrients unavailable for digestion.
  - **Tannins**: These are present in legumes and millets. These interfere with absorption of iron and protein by the body cells.
  - **Trypsin Inhibitors**: These prevent the activity of trypsin in the body. These reduce the digestibility of proteins and their utilisation by the body cells.
  - **Oxalate**: These are present in green leafy vegetables and legumes. These interfere with absorption of calcium in the body.
  - **Goitrogen**: These hinder the absorption of iodine by thyroid gland result in development of iodine deficiency in the body.
- **Beneficial Non-Nutritive Factors of Foods**
- **Phytochemical**: Phytochemical are compounds produced by plants, to prevent themselves from their natural enemies. They are found in fruits, vegetables, grains and beans

- **Anthocyanin** : The grapes, blueberries, cranberries, etc. get their dark colour due to the presence of Anthocyanin.
- **Flavonoid or Isoflavones** : These are found in vegetables, fruits and grains. They act as preventives for heart disease and breast cancer.
- **Artificial Sweeteners**: These taste sweet like sugar but provide less or no energy to the body. These are used in diet food products to make them sweet without increasing their calorie value.

## Effects of Diet on the Performance and Eating for Weight Control

### Revision Notes

- **Role of diet in performance** : A proper diet is essential for good performance. The total energy requirement for a person engaged in physical activity ranges from 3500 to 6000 calories. Diet mainly aims to enhance performance. It improves body composition and increases strength and speed. To identify the role of a particular diet, it would be better to be familiar with the role of vital nutrients on performance. The vital nutrients are discussed below :
  - Carbohydrates** : Carbohydrates are the chief fuel for muscular contraction. Studies suggest that carbohydrates help in increasing the endurance of a sports person. Athletes should not be given carbohydrates in excessive amount, as it may be risky for them. Low level of carbohydrates generally leads to results in exhaustion.
  - Fats** : For a distance runner, high jumper and a gymnast, a minimum amount of fat is desirable. These athletes need minimal fat because, if they put on weight, it will hamper their performance. Distance swimmers need a particular amount of fat distributed close to the skin surface to reduce the heat loss to the water.
  - Proteins** : Proteins are essential for growth and development of various tissues of the body. If fats and carbohydrates are obtainable, they are preferred over protein, as the source of energy. Present studies suggest that protein helps in the growth of lean tissues but does not have any major effect on performance.
  - Vitamins** : In the normal diet for good performances in work and sports, vitamins are essential, but there is no prominent evidence that additional amount of vitamins improves the performance. As a matter of fact, body is not able to store the large amount of vitamins; the majority of the excess amount of vitamins is excreted through the urine, giving only extra work to the excretory organs.
  - Minerals** : The well identified theory about minerals is that their quantity can decrease in hot climate. Sweating reduces the amount of sodium and chloride in the body. Excess quantity of salt consumption can lead to potassium loss and increased water retention.
- **Causes of Dehydration in Athletes** :
  - Inadequate fluid intake
  - Excessive sweating
  - Exercise in dry, hot weather
  - Drinking only when thirsty
  - Failure to replace fluid losses during and after exercise
- **Healthy eating tips for Athletes** :
  - Eat all variety of foods
  - Eat regular meals and snacks
  - Eat food with enough calories
  - Drink plenty of fluids
- **Healthy Weight**  
 "A healthy body weight is a weight at which the body functions most efficiently and effectively, affording maximum protection against illness and disease."

**Height and Weight Chart**

Height (Feet / Metres)	Men Weight (Kgs)	Women Weight (Kgs)
5'-0" or 1.523 m	50.8- 54.4	50.8-54.4
5'-1" or 1.548 m	51.7-55.3	51.7-55.3



5'-2" or 1.574 m	56.3-60.3	53.1-56.7
5'-3" or 1.599 m	57.6-61.7	54.4-58.1
5'-4" or 1.625 m	58.9-63.5	56.3-59.9
5'-5" or 1.650 m	60.8-65.3	57.6-61.2
5'-6" or 1.675 m	61.6-66.7	58.9-63.5
5'-7" or 1.700 m	64.0-68.5	60.8-65.3
5'-8" or 1.726 m	65.8-70.8	62.2-66.7
5'-9" or 1.751 m	67.6-72.6	64.0-68.5
5'-10" or 1.777 m	69.4-74.4	65.8-70.3
5'-11" or 1.802 m	71.2-76.2	67.1-71.7
6'-0" or 1.827 m	73.0-78.5	68.5-73.9
6'-1" or 1.853 m	73.3-80.7	73.3-80.7
6'-2" or 1.878 m	77.6-83.5	77.6-83.5
6'-3" or 1.904 m	79.8-85.9	79.8-85.9

- **Body Mass Index (BMI)** is a measure of body fat calculated on the basis of height and weight. This method applies to both adult to both adult men and women. To calculate BMI, take the weight in kilograms and divide it by height takes in meters. The divide the number once again by height.

$$\text{BMI} = \frac{\text{Weight (in kg)}}{\text{Height (in m)} \times \text{Height (in m)}}$$

#### Weight Category and Body Mass Index(BMI)

Category	BMI
Underweight	<18.5
Normal Weight	18.5–24.9
Overweight	25–29.9
Obesity Class I	30–34.9
Obesity Class II	35–39.9
Obesity Class III	>40

#### ➤ Pitfalls of Dieting :

- (i) **Extreme reduction in calories** : The intake of calories is reduced tremendously in case of dieting. Studies indicate that to meet all nutritional requirements of an individual, 1800 calories a day is not sufficient. If intake of calories is reduced, it produces a havoc weight loss.
  - (ii) **Restriction in some nutrients** : Some nutrients like carbohydrates and fats are restricted in dieting, which can lead to improper functioning of the body.
  - (iii) **Skipping meals** : If meals are skipped, it lowers the metabolism to preserve energy.
  - (iv) **Intake of calories through drinking** : To lose weight, most probably more stress is on not to eat more and not on what to drink. As a fact, beverages like coffee with cream and sugar, sweetened juices and sodas really add to weight gain.
  - (v) **Not performing exercise** : If an individual does not perform exercise and goes on dieting, it will not work properly. In place of losing weight, possibility is likely to gain weight.
- **Food Intolerance** : Food Intolerance is more widespread than food allergy. It is a term used broadly for wide - ranging physiological responses related with a particular food. In simple terms, food intolerance means the individual elements of particular foods that cannot be correctly processed and absorbed by the body but if eaten in a large amount or too often, they create symptoms of food intolerance because the body cannot tolerate unlimited amounts.
- (a) **Causes** : Partial or complete absence of the enzymes accountable for breaking down or absorbing the food elements, causes food intolerance. These deficiencies are generally by birth.
  - (b) **Symptoms** :
    - (i) Nausea
    - (ii) Stomach pain
    - (iii) Nervousness
    - (iv) Diarrhoea

- (v) Vomiting
- (vi) Gas
- (vii) Cramps
- (viii) Heart burn
- (ix) Irritability
- (x) Flatulence

(c) **Management:**

- (i) Fructose intolerance therapy
- (ii) Lactose intolerance therapy
- (iii) Histamine intolerance therapy

These therapies can be applied for managing food intolerance.

- **Food Myths** : Numerous food myths exist not only in India but also all over the world as they sound like they could be true.

The most common food myths which are still widespread in our modern society are given below :

- (i) Potatoes make you fat.
- (ii) Eggs increase cholesterol levels, so avoid them.
- (iii) Drinking while eating makes you fat.
- (iv) Starve yourself if you want to loose weight.
- (v) Fat-free products help in loosing weight.
- (vi) There are some magical food that cause weight loss.
- (vii) Exercise make you eat more.
- (viii) Do not drink milk immediately after eating fish.

## CHAPTER-3

# CHILDREN AND WOMEN IN SPORTS

### Motor Development in Children

## Revision Notes

- **Motor Development** : Motor development involves underlying biological environment and task demands influencing both motor performance and movement abilities of an individual from infancy through late adulthood. It goes on all the time from conception until late teens. At the same time, the nervous system matures for any Types of Motor Development : The brain, nerves and muscles have to work together.
- (i) **Gross Motor Development** : It refers to the movement involving large muscles such as arms, legs or entire body. Performing plenty of movements for developing coordination among different muscles is Gross Motor Development. For example, walking, kicking, sitting, lifting, etc.
  - (ii) **Fine Motor Development** : Fine motor development involves skills of the smaller muscles of the body. Such as, fingers, hands, etc. For example - holding a pencil, catching a cricket ball, picking up toys with fingers, etc.
- **Stages of Motor Development** :
- (i) Infanthood (0 to 2 years)
  - (ii) Early childhood (2 to 6 years)
  - (iii) Middle childhood (7 to 10 years)
  - (iv) Late childhood (11 to 12 years)
- **Exercise Guidelines at different stages of growth and development** : The motor development in children takes place in various stages of growth. The infanthood or infancy is followed by the childhood, stage that is divided into three stages : the infanthood, the early, middle and later childhood.
- **Infanthood (0-2 Years)**
    - Turns head.
    - Moves arms and legs.
    - Reaches and grasps objects.
    - Rolls back from side to side.
    - Crawls, stands and walks.
  - **Early Childhood (2-6 Years)**
    - Basic locomotor.
    - Ball-handling.
    - Eye-hand coordination.

- Running, jumping, hopping, skipping grasping.
  - Games with-simple rules.
  - **Middle Childhood (7 to 10 years)**
    - Fine motor skills.
    - Fine eye-hand coordination.
    - Growth is relatively slow.
    - Cognitive activities.
    - Movement precision.
    - Balancing and coordination.
    - Catching, throwing; kicking.
    - Planned activities games.
  - **Late Childhood (11 to 12 years)**
    - Motor skills perfected.
    - Onset of puberty.
    - Beginning of sexual maturation.
    - Competition.
    - Planned activities, that involve a lot of movements.
- **Obstacles of Motor Development** : Everyone is different and develops at different rates. Abnormalities occur in the muscles, joints and nervous system. These abnormalities include health issues, hearing impairments, heart abnormalities, obesity, etc. It means the child is not doing the things what he/she should be doing at his/her maturity level.

## Factors Affecting Motor Development

### Revision Notes

- **Factors affecting motor development** :
- The development and quality of a child's motor skills are influenced by many factors. These include:
- **Tone**: It refers to the ongoing contraction and state of the muscle at rest. Tone can be normal, hypotonic or hypertonic.
  - **Strength**: It refers to the force of a muscle contraction purposefully exerted against resistance to carryout an activity.
  - **Endurance**: This is the ability to maintain the exertion required for an activity.
  - **Motor Planning**: It is the complex and often intuitive ability to know how to carry out the steps needed to complete a physical, activity.
  - **Sensory Integration**: It is the ability to accurately interpret sensory input from the environment and to produce an appropriate motor response.

## Common Postural Deformities

### Revision Notes

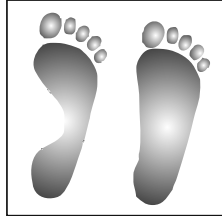
- **Some Common Postural Deformities are** :
1. **Knock Knee** : Knock Knee is a postural deformity in which both the knees touch or overlap each other in the normal standing position. Due to this deformity, an individual usually faces difficulty during walking.



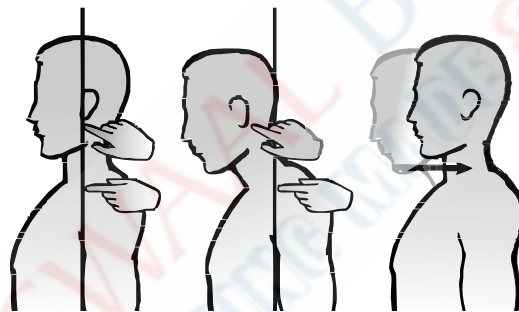
**Knock Knees**

**Causes :**

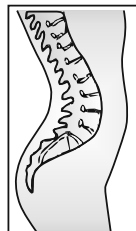
- (i) Weakness of ligaments and muscles
  - (ii) Overweight body
  - (iii) Lack of balanced diet
  - (iv) Lack of Vitamin D
2. **Flat Foot** : It is a deformity in which there is no arch in the foot and the foot is completely flat. The individual faces problem in standing, walking, jumping and running.

**Flat Foot****Causes :**

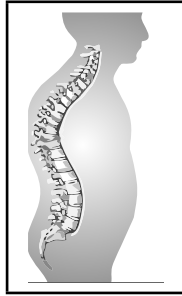
- (i) Heaviness of the body
  - (ii) Standing for a long time
  - (iii) Faulty posture
  - (iv) Use of poor quality footwear not having arch
3. **Round Shoulder** : It is a postural deformity in which the shoulders are drawn forward, the head is extended and the chin points forward.

**Correct      Forward Head****Causes :**

- (i) Due to poor posture in work, particularly in desk job
  - (ii) Faulty furniture
  - (iii) Carrying heavy load on shoulders
  - (iv) Poor posture while sitting and standing
4. **Lordosis** : It is the inward curvature of spine. It is an increased forward curve in the lumbar region. It creates problems in standing and walking.

**Lordosis****Causes :**

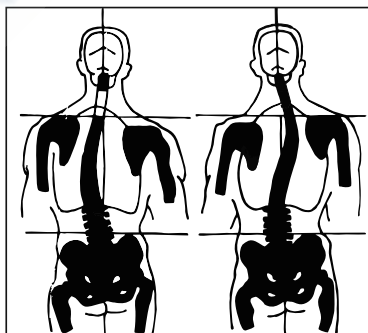
- (i) Habitual overeating
  - (ii) Improper environment
  - (iii) Lack of exercise
  - (iv) Diseases affecting vertebrae
  - (v) Improper development of muscles
5. **Kyphosis** : It is a deformity of the spine in which there is an increase of exaggeration of a backward curve or a decrease of a forward curve. It is also called round upper back.

**Kyphosis****Causes :**

- (i) Reading in dim light
  - (ii) Carrying heavy load on shoulders
  - (iii) Wearing light and shapeless clothes
  - (iv) Habit of bending while walking
6. **Bow legs** : It is a deformity just the reverse of the knock knee position. In fact, if there is a wide gap between the knees, the deformity can be observed easily when individual walks or runs.

**Bow Legs****Causes :**

- (i) Putting extra weight on leg muscles
  - (ii) Lack of balanced diet
  - (iii) Lack of calcium or phosphorus in bones
  - (iv) Improper way of walking
  - (v) Forcing baby to walk at a very early age
7. **Scoliosis** : It is a postural defect in which there is one large lateral curve extending through the whole length of the spine, or there may be two curves. This type of deformity is also called 'S' shape curve.

**Scoliosis****Causes :**

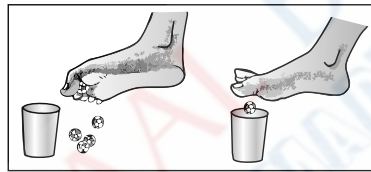
- (i) Short leg of one side
- (ii) One side flat foot
- (iii) Heredity defects
- (iv) One side paralysis of spinal muscles



## Corrective Measures for Postural Deformities

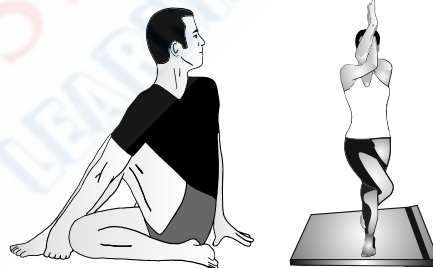
### Revision Notes

- **Postural Deformities :** There are two types of postural deformities *i.e.*, functional and structural. In functional deformities, only the soft tissues *i.e.*, the muscles and ligaments are affected. In this case, correction of postural deformities is possible through various physical activities.
- **Exercises for Kyphosis :**
  - (i) Swimming, Bench press, Push-ups are beneficial as remedial measures.
  - (ii) In corner exercises, the patient stands facing a corner with one hand on each wall, arms at the shoulder level and elbow at 90° from this position, the body moves forward mainly from the angle joint. This is a very good exercise for stretching the pectoral muscles.
  - (iii) Lying on the back on a narrow bench with ring weight hanging from elbows, the arms may flex to avoid any stress to elbows.
  - (iv) Holding a towel or stick in a wide hand grips with arm extended above the head and shoulder gives a good stretch to pectoral muscles and also strengthens posterior neck.
- **Exercises for Flat Foot :**
  - (i) By rising on the toes, by climbing stairs, by cycling.
  - (ii) The emphasis should be upon the exercises involving the flexor, foot and ankle flexion.
  - (iii) Exercise like sitting on a chair grasp a pencil under the toes of one foot and try to write the alphabets with long strokes.
  - (iv) One should wear special shoes properly fitted with arch support made by orthopedic centre.



**Exercise for Flat Foot**

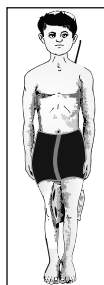
- **Exercises for Bow Legs :**
  - (i) Walking by bending the toes inwards.
  - (ii) Walking for some distance on the inner edge of the feet.
  - (iii) Performing Ardha Matsyendrasana and Garudasana.



**Ardha Matsyendrasana**

**Garudasana**

- **Exercises for Knock Knees :**
  - (i) Use of walking calipers.
  - (ii) Horse riding is the best option for this deformity.
  - (iii) Keeping a pillow between the knees and standing erect for some time.
  - (iv) Performing Padmasana and Gomukhasana.
  - (v) Seated quadriceps contraction and hamstring curls.

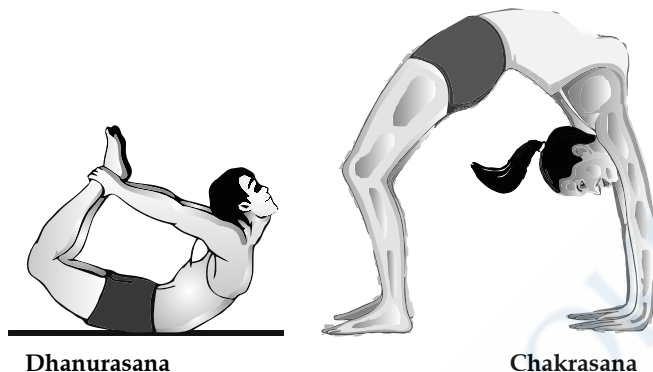


**Exercise for Knock Knees**

➤ **Exercises for Round Shoulders :**

Round shoulders is a common postural deformity. It can be corrected with the help of following exercises :

- (i) Keep your tips of fingers on your shoulders and encircle your elbows in clockwise and anti-clockwise direction for some time.
- (ii) Hold the horizontal bar for some time regularly.
- (iii) Perform Chakrasana and Dhanurasana for some time.

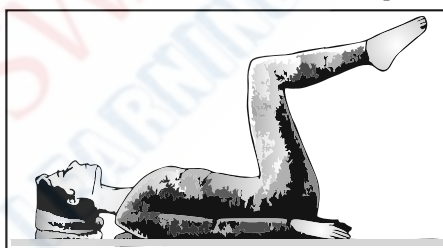


**Dhanurasana**

**Chakrasana**

➤ **Exercises for Lordosis :**

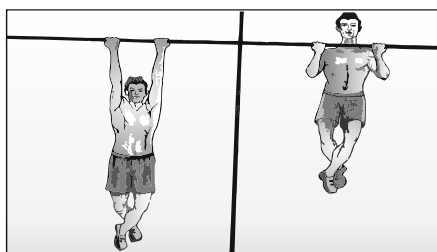
- (i) Lunge forward with knee on a mat. Take position of the foot beyond knee. Place both hands on knee. Straighten hips of rear leg by pushing hips forward and hold stretch. Repeat with opposite side.
- (ii) Sit on a chair with feet wide apart. Bend and position your shoulders between knees. Then reach to the floor under back of chair. Hold this position for some duration.
- (iii) Lie in prone position on the floor. Keep the palms of your hands on the floor according to shoulders' width. Push torso up keeping pelvis on floor. Hold this position for some time.
- (iv) Sit down with knees extended, feet together and hands at sides. After that bend forward, touching the fingers to toes. Hold this position for some time. Then come back and repeat.



**Exercise for Lordosis**

➤ **Exercises for Scoliosis :**

- (i) To swimming by breast stroke technique.
- (ii) Hanging from horizontal bar.
- (iii) Holding the horizontal bar with your hands and swing your body to left and right side.
- (iv) Bending exercise should be performed in opposite side of 'C' shaped curve.



**Exercise for Scoliosis**

## Sports Participation of Women in India

### Revision Notes

- **Sports Participation of Women in India :** Here, sports participation of women means women's participation in the field of sports. In the first Modern Olympics held at Athens in 1896, there was no participation of women. Women started to participate in sports from the year 1900 onwards. They participated in two events only. In 2000, Sydney Olympics the number of women's participation reached to around 5,000 which was a huge change in the time of 100 years. In the Olympics, held in 2012 at London, number of participants were around 11,000 out of which around 5,600 were women. *Saina Nehwal*, *M.C Mary Kom* secured Bronze medal for India. Now, there are many women from our country having a good name at the higher levels. Some of the examples are: *Sania Mirza*, *Mithali Raj*, *Saina Nehwal*, etc. In the 2016 Rio Olympics, shuttler *PV Sindhu* became the first Indian woman to win a silver medal; *Sakshi Malik* first Indian female wrestler to win a medal (bronze), gymnast *Dipa Karmarkar* became the first Indian woman to feature in a gymnastics final, finishing fourth in the vault, and *Lalita Babar* became the first Indian woman to enter a 3,000 m steeplechase final, finishing 10<sup>th</sup>. Eighteen- years old *Aditi Ashok* - the youngest golfer from India-also entered the final round of the women's individual golf eve.
- **Reasons for less participation of Women in Sports :**
  - (i) Lack of fitness
  - (ii) Lack of legislation
  - (iii) Lack of education among women
  - (iv) Lack of interest among spectators
  - (v) Less number of women coaches
  - (vi) Male dominated culture
  - (vii) Lack of personal safety
  - (viii) Less facilities for women
- **Primary Areas of Differences in Gender :** Includes physique (body size), body composition, strength, energy system, cardiovascular endurance capacity, motor skill development, athletic abilities.
- **Effect of Physique and Body Composition on Sports Performance :**

In the high jump, long jump and triple jump, height is also an important factor because the centre of gravity of the body is higher in men in comparison to women.
- **Motor Skills and Athletic Ability :** Males are considered to be stronger, possess greater muscular and cardiovascular endurance and more proficient in almost all motor skills. The number of anatomical, physiological and mechanical reasons are the reasons for low performance in females.

## Special Consideration (Menarche, Menstrual Dysfunction)

### Revision Notes

- **Menarche :** Menarche is a young woman's first menstrual cycle and bleed. Throughout history, menarche has been an important social rite, making a girl's passage to adulthood. However, it happens during a time of physical activity or sexual maturation when a girl usually has her first period between the age of 9 to 15. In 5 percent of cases, menarche occurs between the age of 16 to 18.
- **Menstrual Dysfunction :** It is defined as abnormal bleeding in the absence of intra cavitory or uterine pathology. Menstrual dysfunction in athletes may include primary amenorrhoea, secondary amenorrhoea, oligomenorrhoea and luteal phase deficiency.

In adolescence, it is considered to have delayed puberty when breast development has not begun by 13.5 years of age..

## Female Athletes Triad (Anaemia, Osteoporosis, Amenorrhoea)

### Revision Notes

- **Female Athletes Triad:** The 'female athletes' triad' is a syndrome of three related conditions generally seen in teenage or adult female athletes who aren't meeting their energy requirements, which ultimately leaves them undernourished.

There are :

- (i) **Anaemia :** It is usually defined as a decrease in the amount of Red Blood Cells (RBC's) or haemoglobin in the blood.
  - (ii) **Osteoporosis:** Estrogen is lower in girls with female athletes triad. Low estrogen levels and poor nutrition, especially low calcium intake, can lead to osteoporosis, Osteoporosis is weakening of the bones due to less of bone density and improper bone formation. This condition can ruin a female athlete's career because it may lead to stress, fractures and other injuries.
  - (iii) **Amenorrhoea:** It is a menstrual disorder or illness in females in which females of 18 years of age and above either never begin menstruating or there is absence of menstruation for 3 months or more.
- **Disordered Eating :** Most girls with female athletes triad try to lose weight as a way to improve their athletic performance. The disordered eating that accompanies female athletes triad can range from not eating enough calories to keep up with energy demands to avoiding certain types of food the athlete thinks are 'Bad' (such as foods containing fat) to serious eating disorders like anorexia nervosa or bulimia nervosa.

## CHAPTER-4

### TEST AND MEASUREMENT IN SPORTS

#### Motor Fitness Test—50 M Standing Start, 600 M Run/Walk, Sit & Reach, Partial Curl Up, Push Ups (Boys), Modified Push Ups (Girls), Standing Broad Jump, Agility – 4×10 M Shuttle Run

### Revision Notes

- **Motor Fitness:** It is the capability of an athlete to perform effectively during sports or other physical activity. The motor fitness of an athlete is a combination of five different components each of which is essential for high levels of performance. The components of motor fitness test are:
  - (i) Agility or coordinative ability
  - (ii) Balance
  - (iii) Coordination
  - (iv) Reaction time
  - (v) Power which entails speed and strength.
- **AAHPERD (American Alliance for Health, Physical Education, Recreation and Dance):** In 1965, AAHPERD led to collection of wide-ranging records or data and revision of the national norms. The following test items are included in this test battery:
  - (i) Pull-ups (for boys) or flexed arm hangs (for girls).
  - (ii) Sit ups to a maximum of 50 (for girls) and 100 (for boys).
  - (iii) Shuttle Run
  - (iv) Standing Broad Jump.
  - (v) 50-yard dash
  - (vi) Six-hundred yard run/walk
  - (vii) Softball throw for distance

**In 1976, AAHPERD Youth Fitness Test was again revised and the following changes were made:**

- (i) The softball throw test item was deleted.
- (ii) Fixed number of straight leg sit ups test was changed to bent knee sit-ups performed in 60 seconds.
- (iii) 600-yard run/walk was made optional and the individuals could opt for their 600-yard run/walk or 9 minutes run/walk or 1-mile (for ages 10-12) run/walk, 12 minutes run/walk (for ages 13 and above).

After the revision of AAHPERD Youth fitness test in 1976 or 1.5 mile run/walk following items were finalized in this test battery.

- (i) Pull ups (for boys) or flexed arm hang (for girls)
- (ii) Bent knee sit ups
- (iii) Shuttle run
- (iv) Standing board jump.
- (v) 50-yard dash
- (vi) 600-yard or 9 min run/walk.

➤ **The motor fitness tests are as follows:**

- (i) 50 m standing start
- (ii) 600 m run/walk
- (iii) Partial curl-up
- (iv) Push-up (Boys)
- (v) Modified push-ups (Girls)
- (vi) Standing broad jump
- (vii) 4 × 10 m Shuttle run

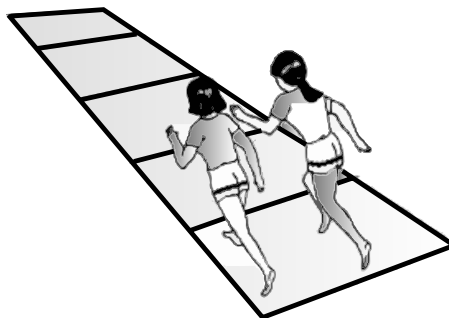
(i) **50 m standing start :**

- **Purpose:** To determine speed
- **Equipment Required:** 50m marked track, measuring tape, Stop watches, wooden clapper or whistle.
- **Procedure:** In this test an area of 50 m is marked on a track with the help of measuring tape. Two parallel lines are drawn 50 m apart. One line is considered as the starting line. The trainee takes the starting position behind the starting line. The starter commands 'Ready' and 'Go'. The word Go is accompanied by a downward sweep of the trainee's arm as a signal to the timer. Two trainees can run at the same time if there are two stopwatches. The score is recorded in seconds.



(ii) **600 m run/walk:**

- **Purpose:** To measure endurance
- **Equipment Required:** 600 m track, wooden clapper or whistle, stop watches.
- **Procedure:** The trainee takes the starting position behind the starting line. Once the signal of ready is given the trainee starts running. During the course of running, he/she may walk also. Many trainees can run at a same time, time is recorded in minutes and seconds.



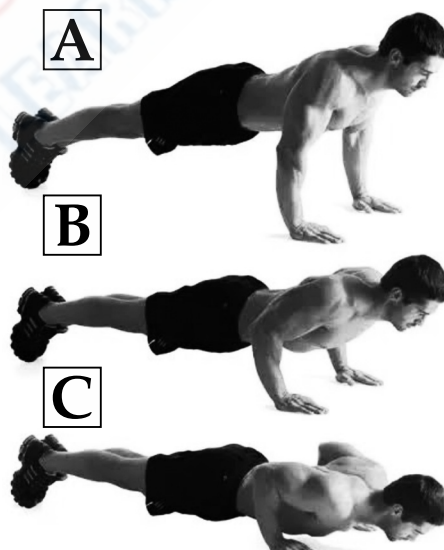


**(iii) Partial curl-up :**

- **Purpose:** To test the strength and endurance of abdominal muscles.
- **Equipment Required:** A flat clean and cushioned surfaced, recording sheet and pen.
- **Procedure:** Initially, the test procedure is explained to the trainee. After that the trainee lies in supine on cushioned surface and the knees should be flexed and feet should be 12 inches from the buttocks. Both the feet should be slightly apart. Arms are extended and rested on thighs. Head should be in neutral position. This is the starting position. Then, the trainee curls up with a slow controlled movement, until his/her shoulder come off the cushioned surface two inches, then goes back down again.
- **Scoring:** Record the total number of partial curl-ups. It should not be counted if the shoulders are not raised up by two inches.

**(iv) Push-up (Boys):**

- **Purpose:** To measure the upper body strength and endurance.
- **Equipment Required:** A floor mat and a paper to record basic information such as age, gender and total number of push-ups performed.
- **Procedure:** After proper warming-up, ask the trainee to take position. In a push-up position, hands and toes should touch the mat/floor. Hands should be shoulder width apart. The upper body and legs should be in a straight line. Elbows should be fully extended keeping the back and knees straight, the trainee lowers the upper body so that elbows may bend to 90 degrees or chest may touch the mat /floor, then returns back to the starting position with the arms extended. Count the total number of push-ups for record.

**(v) Modified Push-ups (Girls):**

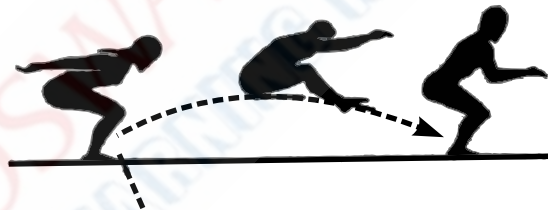
- **Purpose:** To measure the upper body strength and endurance.
- **Equipment required:** A mat and paper to record the basic information like age, gender and push-ups performed .

- **Procedure:** The trainee is asked to take starting position, for modified push-ups hands and knees should touch the mat/floor. Both hands should be shoulder width apart and elbows fully extended. The body should be in a straight line. While keeping this position, the trainee should lower her upper body, so that elbows may bend to 90 degrees. Then the trainee returns back to the starting position. Count the total number of modified push-ups for record.



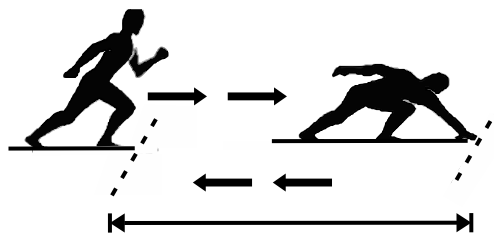
(vi) **Standing broad jump:**

- **Purpose:** To measure explosive strength/ power of legs.
- **Equipment Required:** A sandy long jump pit and a measuring steel tape.
- **Procedure:** A take-off line is marked on the ground. Trainee stands just behind the take-off line with the feet several inches apart. The subject swings the arms and bends the knees to take a jump in the long jump pit. The measurement is noted in feet and inches.



(vii) **4 × 10 m Shuttle run:**

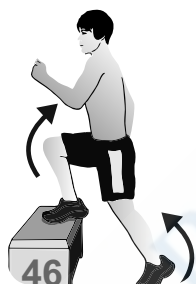
- **Purpose:** To measure agility.
- **Equipment Required:** Two wooden blocks, marker cones, measuring tape, stopwatch and a flat surface with two lines 10 m apart.
- **Procedure:** Mark two parallel lines 3 meters in length, 10 meters apart using marking tape or cones, considering one line as starting line. On the signal 'go', the trainee runs to the wooden blocks, lifts one block, returns to the starting line and places the block behind the line. Then, the trainee returns to the second block, lifts it and then runs across the starting line on the way back.



## Measurement of Cardiovascular Fitness - Harvard Step Test/Rockport Test

### Revision Notes

- **Cardio Vascular Fitness:** It refers to ability of our heart, lungs and organs to consume, transport and utilize oxygen. The maximum value of oxygen our body can consume and use is our VO<sub>2</sub> max.
- **Harvard Step Test:** In 1943, Brouha, for measuring cardiovascular endurance, constructed a very simple and easy test by means of easily obtainable and economical equipment. This is possibly the most widespread test of cardiovascular endurance used in India as well as all over the world. Since this is a strenuous test, it should not be implemented on aged/older persons.



There are two forms of this test:

- (i) **Long Form:** In this, the pulse is counted for 30 seconds on three occasions: 1 minute after exercise (1 to 1.5 minutes), 2 minutes after exercise (2 to 2.5 minutes) and 3 minutes after exercise (3 to 3.5 minutes).

**Scoring:** A Physical Efficiency Index (PEI) is computed using the formula:

$$\text{PEI} = \frac{\text{Duration of exercise in seconds} \times 100}{2 \times \text{sum of pulse counts in recovery}}$$

The PEI standards for the long form are as follows:

Below 55	–	poor
55 to 64	–	low average
65 to 79	–	high average
80 to 89	–	good
above 89	–	excellent

For individuals who do not complete the 5-minutes test, the following score card standards may be used.

Less than 2 minutes	–	25
From 2 to 3 minutes	–	38
From 3 to 3.5 minutes	–	48
From 3.5 to 4 minutes	–	52
From 4 to 4.5 minutes	–	55
From 4.5 to 5 minutes	–	59

- (ii) **Short Form:** In this the pulse is counted for only 30 seconds i.e., 1 minute after exercise (1 to 1.5 minutes).

Scoring: PEI = duration of exercise in seconds × 0.55 × pulse count for 1 to 1.5 minutes exercise.

PEI stands for Physical Exercise Index. The PEI standards for the short form are:

Below 50	–	Poor
50 to 80	–	Average
Above 80	–	Good

- **Rock Port One Mile Test:** The objective of this test is to monitor the development of the athletes VO<sub>2</sub> max i.e., maximum value of oxygen. Requirements are:
  - (i) 400 m track
  - (ii) Stopwatch
  - (iii) Weighing scale and Assistant

The aim of the test is to walk one mile (1609 meter) as fast as possible.

## Measurement of Flexibility: Sit and Reach Test

### Revision Notes

- **Flexibility:** It is the range of motion around a joint as determined by elasticity of the muscles, tendons and ligaments with the muscles and the joint.
- The Sit and Reach Test is the most common way to measure lower back and hamstring flexibility.
- It is used by exercise physiologists and fitness trainers to understand the level of flexibility before starting an exercise program.
- **Procedure to Perform the Sit and Reach Test**
  - Get a testing box
  - The box must be prevented from slipping (may be placed against a wall).
  - The subject after removing the shoes is asked to keep his/her feet touching the testing box as sitting on the floor with knees straight.
  - The subject places one hand on top of the other in a way that the middle fingers of both hands are joined on similar length.
  - The subject is asked to bend forward and put his/her hands above the measuring scale lying on the top of the box by its 10-inch mark coinciding with the front border of the testing box.
  - The subject is instructed to hold the farthest position for at least one second by sliding his/her hands along with the measuring scale as far as possible without bouncing.
  - The subject is asked to sit down on the floor with the above mentioned oblique line and horizontally straight on the ground with his/her heels coinciding. A different subject of tester is asked to stand and support his or her toes against the heels of the examinee.
  - One on each side of the examinee, there are two assistants requested to grip the knees in a locked position to prevent any bending movement while the examinee initiates stretching his/her hands forward and pushes the flex measure case as far down the yardstick as possible.
- **Sit and Reach Test Standards**
  - **Adult Men** - results in inches
    - Above 7 = Excellent
    - 5 to 6 = Good
    - 3 to 4 = Above Average
    - 1 to 2 = Average
    - 0 to 1 = Below Average
    - -2 and Below = Poor
  - **Adult Women** - results in inches
    - Above 8 = Excellent
    - 6 to 7 = Good
    - 4 to 5 = Above Average
    - 1 to 3 = Average
    - 0 to 1 = Below Average
    - -2 and Below = Poor

## Rikli and Jones : Senior Citizen Fitness Test

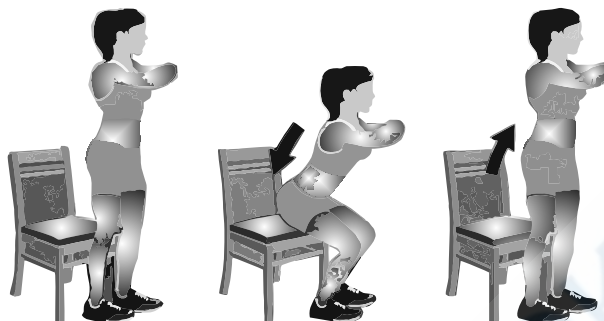
### Revision Notes

- Rikli and Jones prepared various physical fitness tests for senior citizens. Senior citizens can't do exhaustive workouts, that is why easy tests prepared for different body parts are given as:
  - Chair Stand test for lower body strength.
  - Arm Curl Test for upper body strength endurance.
  - Chair sit and reach test for lower body flexibility.
  - Back scratch test for upper body flexibility.

- Eight foot up and go test for coordination and agility.
- Six minutes walk test for aerobic fitness and endurance.

➤ **Chair Stand Test for Lower Body Strength:**

- **Purpose:** This test assesses leg strength and endurance of senior citizens.
- **Equipment Required:** A straight or folding chair without arm rests (seat 17 inches or 44 cm high) and a stopwatch.



- **Procedure:** Put a chair against a wall to keep it from moving or causing accidental fall. The subject is to sit on the chair with both feet away from each other at a length of own shoulders. The wrists are held in a crossed position and held close to the chest. At the signal of the person taking the test, the subject stands up completely and then sits back completely. The process is repeated for 30 seconds. One complete cycle means standing up completely and sitting back. The number of completed cycles in 30 seconds are awarded as final score.

Age	Below average	Average	Above average
60-64	< 14	14 to 19	> 19
65-69	< 12	12 to 18	> 18
70-74	< 12	12 to 17	> 17
75-79	< 11	11 to 17	> 17
80-84	< 10	10 to 15	> 15
85-89	< 8	8 to 14	> 14
90-94	< 7	7 to 12	> 12

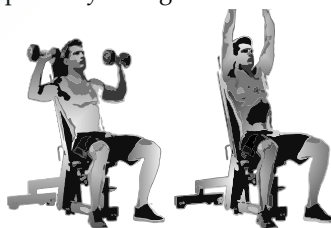
Norms for Men

Age	Below average	Average	Above average
60-64	< 12	12 to 17	> 17
65-69	< 11	11 to 16	> 16
70-74	< 10	10 to 15	> 15
75-79	< 10	10 to 15	> 15
80-84	< 9	9 to 14	> 14
85-89	< 8	8 to 13	> 13
90-94	< 4	4 to 11	> 11

Norms for Women

➤ **Arm Curl Test for Upper Body Strength:**

- **Purpose:** This measures the upper body strength and endurance.



- **Equipment Required:** 5-pounds weight for women, 8-pounds weight for men, a chair, stopwatch.
- **Procedure:** In this test, the subject sits on a chair. The subject then holds the weight in the dominant arm in the vertical down position from the shoulder. The other arm is raised in vertical up position above the shoulder which is kept there stationary either on own effort or with the help of the support from the person taking the test. The dominant arm carrying the weight is then required to be curled upto shoulder height and returned back to the starting position. The number of completed curl-ups in 30 seconds is awarded as the final score.

Age	Below average	Average	Above average
60-64	< 16	16 to 22	> 22
65-69	< 15	15 to 21	> 21



70-74	< 14	14 to 21	> 21
75-79	< 13	13 to 19	> 19
80-84	< 13	13 to 19	> 19
85-89	< 11	11 to 17	> 17
90-94	< 10	10 to 14	> 14

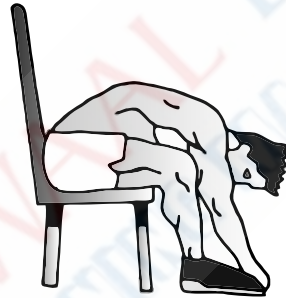
#### Norms for Men

Age	Below average	Average	Above average
60-64	< 13	13 to 19	> 19
65-69	< 12	12 to 18	> 18
70-74	< 12	12 to 17	> 17
75-79	< 11	11 to 17	> 17
80-84	< 10	10 to 16	> 16
85-89	< 10	10 to 15	> 15
90-94	< 8	8 to 13	> 13

#### Norms for Women

##### ➤ Chair Sit and Reach Test for lower body flexibility:

- **Purpose:** This measures lower body flexibility.
- **Equipment Required:** Ruler, straight back or folding chair (seat 17 inches/44 cm high)



- **Procedure:** In the test, the subject sits on the edge of a chair with the feet flat on the floor. Place the hands on top of each other in a way that both middle fingers are on top of each other and the tips are touching. The subject is then required to exhale and bend towards the toes keeping the straight back and head up. The subject is not allowed to bounce or jerk the body. The position is maintained for 2 seconds and score awarded on the basis of the following table showing distance between the middle finger tips and the toes.

Age	Below average	Average	Above average
60-64	< -2.5	-2.5 to 4.0	> 4.0
65-69	< -3.0	-3.0 to 3.0	> 3.0
70-74	< -3.5	-3.5 to 2.5	> 2.5
75-79	< -4.0	-4.0 to 2.0	> 2.0
80-84	< -5.5	-5.5 to 1.5	> 1.5
85-89	< -5.5	-5.5 to 0.5	> 0.5
90-94	< -6.5	-6.5 to -0.5	> 0.5

#### Norms for Men

Age	Below average	Average	Above average
60-64	< -0.5	-0.5 to 5.0	> 5.0
65-69	< -0.5	-0.5 to 4.5	> 4.5
70-74	< -1.0	-1.0 to 4.0	> 4.0
75-79	< -1.5	-1.5 to 3.5	> 3.5
80-84	< -2.0	-2.0 to 3.0	> 3.0
85-89	< -2.5	-2.5 to 2.5	> 2.5
90-94	< -4.5	-4.5 to 1.5	> 1.0

#### Norms for Women

##### ➤ Back Scratch test for Upper Body Flexibility:

- **Purpose:** This test measures upper arm and shoulder girdle flexibility.
- **Equipment Required:** None



- **Procedure:** In this test, the subject is required to stand. One hand is put behind the head and the other hand is put down the back with the palm facing the body. The other hand is put at the back from the bottom side with the palm facing away from the body. The subject is then required to try and touch the fingers. The process is repeated for both the shoulders.

Age	Below average	Average	Above average
60-64	> 6.5	6.5 to 0	< 0
65-69	> 7.5	7.5 to - 1.0	< - 1.0
70-74	> 8.0	8.0 to - 1.0	< - 1.0
75-79	> 9.0	9.0 to - 2.0	< - 2.0
80-84	> 9.5	9.5 to - 2.0	< - 2.0
85-89	> 10.0	10.0 to - 3.0	< - 3.0
90-94	> 10.5	10.5 to - 4.0	< - 4.0

Norms for Men

Age	Below average	Average	Above average
60-64	> 3.0	3.0 to 1.5	< 1.5
65-69	> 3.5	3.5 to 1.5	< 1.0
70-74	> 4.0	4.0 to 1.0	< 1.0
75-79	> 5.0	5.0 to 0.5	< 0.5
80-84	> 5.5	5.5 to 0	< 0
85-89	> 7.0	7.0 to - 1.0	< - 1.0
90-94	> 8.5	8.5 to - 1.0	< - 1.0

Norms for Women

➤ **Eight foot up and go test for Agility:**

- **Purpose:** This test measures speed, agility and balance while moving.
- **Equipment Required:** Stopwatch, straight back or folding chair (seat 17 inches/44 cm high), cone/marker, measuring tape, area clear of obstacles.



- **Procedure:** Place the chair next to a wall for safety and the marker eight feet in front of the chair. Clear the path between the chair and the marker. The subject starts fully seated, hands resting on the knees and feet flat on the ground. On the command 'Go' the stopwatch is started and the subject stands and walks (no running) as quickly as possible to and around the cone, returning to the chair to sit down.

Age	Below average	Average	Above average
60-64	> 5.6	5.6 to 3.8	< 3.8
65-69	> 5.7	5.7 to 4.3	< 4.3
70-74	> 6.0	6.0 to 4.2	< 4.2
75-79	> 7.2	7.2 to 4.6	< 4.6
80-84	> 7.6	7.6 to 5.2	< 5.2
85-89	> 8.9	8.9 to 5.3	< 5.3
90-94	> 10.0	10.0 to 6.2	< 6.2

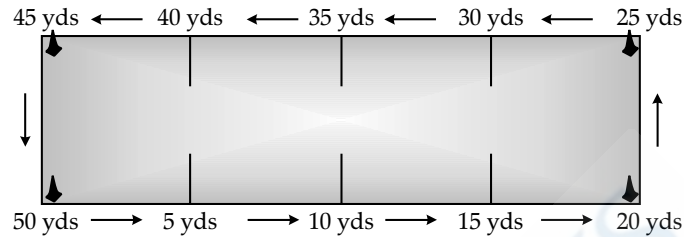
Norms for Men

Age	Below average	Average	Above average
60-64	> 6.0	6.0 to 4.4	< 4.4
65-69	> 6.4	6.4 to 4.8	< 4.8
70-74	> 7.1	7.1 to 4.9	< 4.9
75-79	> 7.4	7.4 to 5.2	< 5.2
80-84	> 8.7	8.7 to 5.7	< 5.7
85-89	> 9.6	9.6 to 6.2	< 6.2
90-94	> 11.5	11.5 to 7.3	< 7.3

Norms for Women

➤ **Six Minute Walk test for aerobic endurance:**

- **Purpose:** This test measures aerobic fitness.
- **Equipment Required:** Measuring tape to mark out the track distances, stop watch and chairs positioned for testing.
- **Procedure:** The walking course is laid out in a 50 yard 45.7 metres rectangular area (dimension 45× 5 yards) with cones placed at regular intervals to indicate distance walked. The aim of this test is to walk as quickly as possible for six minutes to cover as much ground as possible.



## General Motor Ability Test: Barrow Item (Standing Broad Jump, Zig Zag Run, Medicine Ball Put)

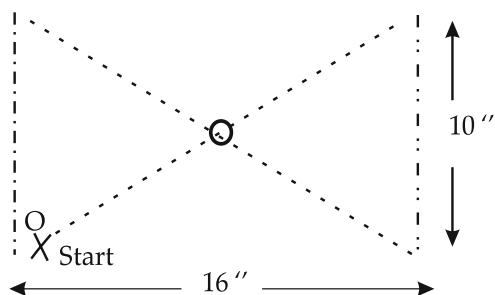
➤ **Barrow Three Item:** The general motor ability tests are given below:

- **Standing Broad Jump:** The distance in the Standing Broad Jump is measured in inches and feet. For the standing time a piece of tape is placed on the floor and perpendicular to the jumping area. Each person is permitted one practice and three trials. The distance of the best trial is recorded and the correct number of points are given. The jump is disqualified if the athlete's toe touches in front of the standing line on his take off.

**TABLE I**  
**NORM'S USED FOR STANDING BROAD JUMP**

Distance in feet and inches	Score	Distance in feet and inches	Score	Distance in feet and inches	Score
11' 1"	100	8' 9"	68	6' 5"	33
11' 0"	99	8' 8"	66	6' 4"	31
10' 11"	98	8' 7"	65	6' 3"	30
10' 10"	97	8' 6"	64	6' 2"	29
10' 9"	96	8' 5"	63	6' 1"	28
10' 8"	95	8' 4"	61	6' 0"	26
10' 7"	94	8' 3"	60	5' 11"	25
10' 6"	93	8' 2"	59	5' 10"	24
10' 5"	92	8' 1"	58	5' 9"	23
10' 4"	91	8' 0"	56	5' 8"	22
10' 3"	90	7' 11"	55	5' 7"	20
10' 2"	89	7' 10"	54	5' 6"	19
10' 1"	87	7' 9"	53	5' 5"	18
10' 0"	86	7' 8"	51	5' 4"	16
9' 11"	85	7' 7"	50	5' 3"	15
9' 10"	84	7' 6"	49	5' 2"	14
9' 9"	83	7' 5"	48	5' 1"	13
9' 8"	82	7' 4"	47	5' 0"	11
9' 7"	81	7' 3"	45	4' 11"	10
9' 6"	80	7' 2"	44	4' 10"	9
9' 5"	79	7' 1"	43	4' 9"	8
9' 4"	77	7' 0"	41	4' 8"	6
9' 3"	75	6' 11"	40	4' 7"	5
9' 2"	74	6' 10"	39	4' 6"	4
9' 1"	73	6' 9"	38	4' 5"	3
9' 0"	71	6' 8"	36	4' 4"	1
8' 11"	70	6' 7"	35		
8' 10"	69	6' 6"	34		

- **Zig Zag Run:** The course used is set up in a rectangular form 16 by 10 feet. Bowling pins can be used as centre and covers obstacles. Each athlete is allowed a trial run. He has to start from the point X (given in the below figure) and run the prescribed figure three times around. The time is recorded to the nearest tenth of a second with stopwatch.



**TABLE II**  
**NORM'S USED FOR ZIGZAG RUN**

- **Medicine Ball Put:** The medicine ball put has length of 70 feet, marked off in half foot intervals. Two lines, a standing and a finishing are marked off perpendicular to the measurement for the throwing area. The two lines should be 15 feet apart. Each athlete is permitted one practice and three trial puts. The distance of the best trial is recorded.

**NOTE:** For boys the medicine ball weight is 3 Kg  
For girls the medicine ball weight is 1 Kg.

**TABLE III**  
**NORM'S USED FOR MEDICINE BALL PUT**

Distance in feet	Score	Distance in feet	Score	Distance in feet	Score	Distance in feet	Score
72	100	56 - 56.5	75	40	50	23.5	25
71.5	99	55.5	74	39.5	49	22.5 - 23	24
70.5 - 71	98	55	73	38.5 - 39	48	22	23
70	97	54.5	72	38	47	21.5	22
69.5	96	53.5 - 54	71	37.5	46	21	21
69	95	53	70	37	45	20 - 20.5	20
68 - 68.5	94	52.5	69	36 - 36.5	44	19.5	19
67.5	93	51.5 - 52	68	35.5	43	19	18
67	92	51	67	35	42	18.5	17
66.5	91	50.5	66	34.5	41	17.5 - 18	16
65.5 - 66	90	50	65	33.5 - 34	40	17	15
65	89	49 - 49.5	64	32.5	39	16.5	14
64.5	88	48.5	63	32	38	15.5 - 16	13
64	87	48	62	31 - 31.5	37	15	12
63 - 63.5	86	47 - 47.5	61	30.5	36	14.5	11
62.5	85	46.5	60	30	35	14	10
62	84	46	59	29 - 29.5	34	13.5	9
61.5	83	45.5	58	28.5	33	12.5 - 13	8
60.5 - 61	82	44.5 - 45	57	28	32	12	7
60	81	44	56	27.5	31	11.5	6
59.5	80	43.5	55	26.5 - 27	30	10.5 - 11	5
59	79	42.5 - 43	54	26	29	10	4
58 - 58.5	78	42	53	25.5	28	9.5	3
57.5	77	41.5	52	24.5 - 25	27	9	2
57	76	40.5 - 41	51	24	26	8.5	1

## CHAPTER-5

# BIOMECHANICS & SPORTS

### Biomechanics

#### Revision Notes

- Biomechanics is the field in sport science that applies laws of mechanics and physics to human performance, to gain a greater understanding of performance in athletic events through modelling, simulation, and measurement. It is also necessary to have a good understanding of the applications of physics in sport, as the principle of physics such as motion, resistance, momentum and friction have their application in most sporting events. The general role of biomechanics is to understand the mechanical - cause effect relationships that determine the motions of living organisms.
- **Biomechanics:** It focuses on the application of the scientific principles of mechanical physics to understand the movements and actions of human bodies, and their different parts (e.g. holding a tennis racket).
- **Kinematics:** It analyses motion in terms of time, displacement, velocity, or acceleration.
- **Kinetics:** It is that aspect of dynamics which considers the force or forces which cause object or bodies to move.
- **Force:** It is a pull or push by one body acting upon another. It tends to change the body's state of rest or motion.

### Types of Movements

#### Revision Notes

- **Types of Movements:**
  - (i) Flexion                      (ii) Extension                      (iii) Abduction                      (iv) Adduction
- (i) **Flexion:** Flexion refers to a movement that decreases the angle between two body parts. Flexion at the elbow is decreasing the angle between the ulna and the humerus. When the knee flexes, the ankle moves closer to the buttock, and the angle between the femur and tibia gets smaller.



Flexion

- (ii) **Extension:** It refers to a movement that increases the angle between two body parts. Extension at the elbow is increasing the angle between the ulna and the humerus. Extension of the knee straightens the lower limbs.



**Extension**

- (iii) **Abduction:** Abduction is a movement away from midline – just as abducting someone is to take them away. For example, abduction of the shoulder raises the arms out to the side of the body.

**Abduction**

- (iv) **Adduction:** It is a movement towards the midline. Adduction of the hip squeezes the legs towards each other.

**Adduction**

## Newton's Law of Motion and its Application in Sports

### Revision Notes

- **Law of Inertia:** It is the first law of motion. According to this law, "A body at rest will remain at rest and a body in motion will remain in motion at the same speed and in the same direction unless acted upon by an external force."

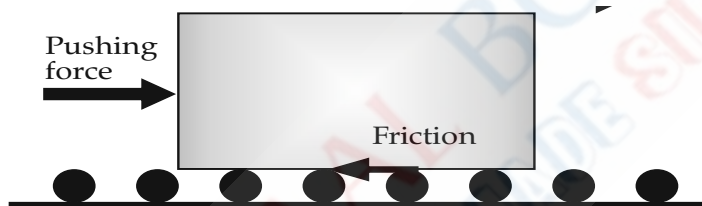
**Example:** To take start in sprint races, to lift the opponent in wrestling, to start hammer throw.

- **Law of Acceleration:** It is the second law of motion. According to this law, "A change in acceleration of an object is directly proportional to the force producing it and inversely proportional to its mass." If two unequal forces are applied to the objects of equal mass, the object that has a greater force applied will move faster. Conversely, if two equal forces are applied to objects of different masses, the higher mass will travel at a faster speed.  
**Example:** In baseball player hits the ball hard to throw it far away.
- **Law of Reaction:** It is the third law of motion. According to this law, "For every action, there is an equal and opposite reaction." **Example:** The swimmer pushes the water in the backward direction with a certain force. Water pushes the man forwards with an equal and opposite force.

## Friction and Sports

### Revision Notes

- The force acting along two surfaces in contact, which opposes the motion of one body over the other is called the force of friction. It is important in sports. The larger the area of contact between the surfaces, the greater the force of friction. When both the surfaces are smooth, the force of friction reduces almost to zero. Generally, there are two causes of friction:
  - (i) The roughness or irregularities of the surface;
  - (ii) The strong atomic or molecular force of attraction between the two surfaces at the point of actual contact.



- **Characteristics of friction:**
  1. Friction is the force resisting the relative motion of solid surfaces, fluid layers, and material elements sliding against each other.
  2. Friction is a force created whenever two surfaces move or try to move over each other.
  3. Friction always opposes the motion or attempted motion of one surface area across another surface.
  4. Friction is also dependent on the amount of contact force pushing the two surfaces together.
- **Types of Friction:**  
There are generally two types of friction:
  1. Static Friction
  2. Dynamic Friction
  1. **Static Friction:** Static friction is when a force is applied to an object but does not cause it to move. Example: Pushing a wall. Static friction comes into play when a body is forced to move along a surface and movement does not start. The magnitude of static friction remains equal to three applied external forces and direction of motion. The magnitude of static friction depends upon coefficient of static friction and N (Net normal reaction of the body).
  2. **Dynamic Friction:** Dynamic friction is a divergent force that comes into action when one body moves over the surface of one more body. Additionally, dynamic friction is of two types *i.e.*, sliding friction and rolling friction. These are:
    - (i) **Sliding friction:** Sliding friction is the divergent force that comes into action as the body slides over the surface of the other body. For instance, ice skating and in pole vault, planting the pole.
    - (ii) **Rolling Friction:** Rolling friction occurs when an object rolls over another (something with wheels or circular like a ball). Example riding a motorcycle. Rolling frictional force is a force that slows down the motion of a rolling object. Basically, it is a combination of various types of frictional forces at the point of contact of the wheel and ground or surface. When a hard object moves along a hard surface then static and molecular frictional force retard its motion. When a soft object moves over a hard surface then its distortion makes it slow down.