

CHAPTER

07

Physiology and Injuries in Sports

Physiology is very essential to understand how to attain physical fitness in order to enhance the performance in sports. It is the scientific study of human body and its systems.

The scientific principles of exercise in physiology, are applied through a range of physiological interventions or assessments, which facilitate the profiling and monitoring of specific parameters relevant to optimise sports performance.

In other words, it can be said that physiology is basically the study of how exercises or sports activities alter the structure and functioning of our body.

Physiological Factors Determining Components of Physical Fitness

The components of physical fitness are determined by the physiological factors. The main components of physical fitness are strength, speed, endurance, flexibility, etc. These components that make a person physically fit and their determining factors are described below

Muscular Strength

One of the basic requirements for success in all movements is muscular strength. It may be defined as the maximum force or tension a muscle or a muscle group can exert against a resistance.

Physiologically, the muscle will increase its strength only through

CHAPTER CHECKLIST

- Physiological Factors Determining Components of Physical Fitness
 - Effects of Exercise
 - Sports Injuries
-

The development of strength is specific to the muscle or muscles involved in a particular activity.



Strength

Factors Determining Strength

The factors which determine strength are explained below

1. **Size of the Muscle** The size of the muscle determines the strength possessed by an individual. It is well known fact that bigger and larger muscles can produce more force.

Males have bigger and larger muscles due to which they have more strength than females.

The muscle size can be increased with the help of various methods such as weight training, etc. which will also improve the muscular strength.

2. **Body Weight** There is a positive correlation between the body weight and strength. It has been noticed that individuals with heavier body weight are stronger than the individual with the lighter weight. Thus, body weight also determines the strength of an individual.

3. **Muscle Composition** Muscles consist of two types of fibres *i.e.* *fast twitch fibres* (white fibres) and *slow twitch fibres* (red fibres).

The fast twitch fibres are capable to contract faster and therefore, they can produce more force.

On the contrary, the slow twitch fibres are not capable to contract faster but they are capable to contract for a longer duration.

Muscles containing more percentage of fast twitch fibres produce more strength. The percentage of fast and slow twitch fibres is genetically determined and

4. **Nerve Impulse** The nervous system also plays an important role in muscle strength. A muscle consists of many motor units. The number of contracting motor units determines the total force. If muscles contract with greater intensity, more strength will be produced.

5. **Age** Age is a factor which effects the muscle strength. Muscle strength is maximum generally in the age of 15-30 years.

It declines with the age but it is primarily due to decrease in muscle cross-sectional area and a decline in the number of contractile tissues within the muscle fibres. Regular strength training limits loss of muscle strength with ageing.

Speed

It is the rapidity with which one repeats successive movements in the same pattern. It may also be defined as the ability of a person to move quickly over a distance.

For example, 50 m and 100 m dashes. Individuals with greater speed usually also have superior reaction time.



Speed

Factors Determining Speed

Factors which determine the speed are explained below

1. **Bio-chemical Reserves and Metabolic Power** For maximum speed performance, the muscles require more amount of energy at a very high rate of consumption.

For this purpose, the phosphogen Adenosine Triphosphate (ATP) and Creatine Phosphate (CP)

If ATP and CP store is less in contracting muscles, the muscle contractions due to insufficient energy supply become slow after a short time.

The metabolic power depends upon the energy supplied through certain enzymes.

Proper working of the enzymes means high rate of metabolism which increases speed of doing work.

- 2. Muscle Composition** Muscles consist of two types of fibres *i.e.* *fast twitch fibres (white fibres)* and *slow twitch fibres (red fibres)*. A person containing more of fast twitch fibres will have greater speed.
- 3. Mobility of the Nervous System** The rapid contraction and relaxation of the muscles takes place due to rapid excitation (state of enhanced activity of the cell) of the nervous system. The rapid movements give greater speed.
The nervous system can maintain this rapid excitation and inhibition only for a few seconds after which the excitation spreads to the neighbouring centres causing tension in the entire body. This results in decrease in speed.
The mobility of the nervous system can be trained only to a limited extent.
- 4. Explosive Strength** For very quick and explosive movements, explosive strength is indispensable. It depends upon metabolic composition, muscle size and muscle coordination.
The explosive strength of the muscles can be improved through training, which will also improve the speed upto a certain limit.
- 5. Flexibility** Flexibility refers to the range of movement around a joint. It covers all joints and has significant impact on performance.
Lack of good flexibility can have a direct negative impact on speed due to the limitations of joint motion.
Flexibility helps in enhancing speed by utilising explosive power.

Endurance

It can be defined as the ability of a muscle or muscle group to perform repeated contractions against a resistance / load or to sustain contraction for an extended period of time with less discomfort and more rapid recovery.

In other words, it is the ability to withstand fatigue.



Endurance

Factors Determining Endurance

The factors which determine the endurance are explained below

- 1. Aerobic Capacity** It refers to the capacity to maintain the adequate supply of Oxygen (O_2) to the working muscles. This influences the level of endurance.

If the muscles get adequate supply of O_2 for a longer duration, then the athlete will have more endurance.

The aerobic capacity is influenced by O_2 intake, O_2 transport, O_2 uptake and energy reserves.

These are as follows

- **Oxygen Intake** It is the amount of O_2 taken by the lungs. This intake depends on the vital capacity, lung size, number of active alveoli, strength of respiratory muscles and size of chest cavity.
- **Oxygen Transport** The oxygen transport depends on the amount of oxygen, which the blood has absorbed from the lungs and the ability of the circulatory system to carry this quickly to the working muscles.
The amount of oxygen absorbed into the blood depends on the speed of blood flow through the lungs and on the blood haemoglobin.

The transportation of oxygenated blood depends on the capacity of heart. This capacity can be improved by training.

- **Oxygen Uptake** It is the amount of O_2 that can be absorbed and consumed by the working muscles from the blood.

This depends on the blood flow, temperature, pressure of O_2 in the blood, metabolic capacity of mitochondria, speed and amount of O_2 consumption.

- **Energy Reserves** It means the availability of fuel to the muscles for getting energy. This depends on the muscle glycogen and sugar level in the blood.

A person having high energy reserves will have high endurance capacity and *vice-versa*. If the energy reserves falls down from a certain level, then fatigue occurs.

2. **Anaerobic Capacity** The working capacity of muscle in absence of oxygen is called anaerobic capacity. More or less anaerobic capacity is required in all kinds of endurance activities. Anaerobic capacity depends on the following factors

- **Phosphagen Store** It consists of Adenosine Triphosphate (ATP) and Phosphocreatine (CP) which helps in producing energy.
- **Buffer Capacity** It means total storage of Alkali reserve in the body to fight against the effect of lactic acid.
- **Lactic Acid Tolerance** The ability to tolerate the higher concentration of lactic acid is a very important factor in determining anaerobic capacity. This is important for sports as high level of endurance is required. This tolerance capacity can be improved through training.

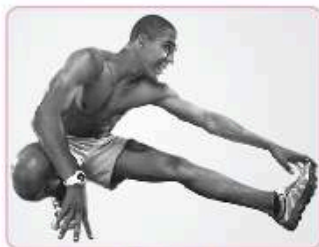
3. **Movement Economy** Energy may be saved if the movements are correct, so the economical movements are necessary for enhancing endurance. Economical movements varies from one sport or exercise to another. For example, in football, 15-25% of the energy can be saved, if the movements are correct.

4. **Muscle Composition** Among the presence of fast and slow twitch fibres, the slow twitch fibres are useful for endurance. Therefore, muscle

Flexibility

In general, flexibility is that quality of the muscles, ligaments and tendons that enables the joints of the body to move easily through a complete range of movement.

More flexibility of the joints gives better movement of limbs, increased speed and enhances better control of the body.



Flexibility

Factors Determining Flexibility

The factors which determine the flexibility are explained below

1. **Joint Structure** The joint structure of a person determines the range of motions and hence level the flexibility of an individual.
For example, the ball and socket joint of the shoulder has the greatest range of motion in comparison to the knee joint.
2. **Age and Gender** The age of a person as well as the gender determines the level of flexibility. Flexibility decreases with advancement of age. Females are more flexible than males. It can be enhanced with the help of training, as strength and endurance are enhanced.
3. **Stretchability of Muscles** If the muscles are regularly stretched, then they remain flexible. The stretchability of muscles depends on the amount of exercises and physical activities.
4. **Previous Injury** Any kind of internal or external injury may lead to thickening or shrinking of fibrous tissues which may become less elastic. This can lead to reduction in flexibility.
5. **Internal Environment** Internal environment of the athlete influences the flexibility. For example, 10 minutes of warm bath increases body temperature

6. **Muscle Strength** The muscle should have a minimum level of strength to make the movement, especially against the gravity or external force. Weak muscles can become a limitation for achieving higher range of movement.

Muscle strength is highly trainable and therefore can enhance flexibility of a person to a great extent.

7. **Active and Sedentary Lifestyle** Regular activities enhance the flexibility, whereas inactive individual loses flexibility due to the soft tissues and joints shrinking and losing extensibility.

Effects of Exercise

Effect of exercise on Cardiorespiratory system and muscular respiratory system are as follows

Effects of Exercise on Cardiorespiratory System

The functioning and efficiency of cardiorespiratory system reduces with age. In order to keep it in perfect condition, exercises are pre-requisite.

Exercises helps in improving the functioning of cardiorespiratory system, which increases the overall fitness of an individual.

Frequent exercises helps in reducing risk of cardiorespiratory diseases. Exercises increases cardiac output, heart size, blood pressure, etc. thus they should be performed regularly.

Effects of exercise on cardiorespiratory system are

1. **Increase in Heart Size** Regular exercises develop the muscles of the heart. It increases the size of the heart along with the strengthening of heart.

Thus, the heart becomes more efficient in doing its job with the capacity to pump more oxygen-rich blood.

2. **Decrease in Cholesterol Level** Regular exercise reduces the level of cholesterol in our blood. The level of cholesterol in our blood is directly linked with blood pressure.

Exercise decreases the level of low-density protein and increases the level of high-density protein.

It simply means that exercise decreases the LDL (bad cholesterol) and increases HDL (good

cholesterol) programme is allotted to an individual whose initial resting heart rate is 72 beats per minute, after the training, his resting heart rate may be reduced upto 10 beats per minute.

Thus, a proper and long-term training programme decreases the resting heart rate.

4. **Stroke Volume** The volume of blood pumped into the heart with every heartbeat is known as the stroke volume. In an untrained male, it is 50-70 ml/beat. In a trained male athlete, it may be 70-90 ml/beat. The stroke volume increases in response to the intensity of the exercises and also pumps more blood when required.

5. **Blood Flow** Regular exercise increases blood flow in the body. During exercises, muscles need more blood, then body increases number of capillaries. The existing capillaries also open wider.

With increasing intensities of exercise, a greater accumulation of lactic acid and the production of other metabolic end products (potassium, phosphate) occurs. This increases blood flow in the cardiac output, while it decreases in kidneys and abdomen.

6. **Cardiac Output** It is the amount of blood pumped by the heart in one minute. In other words, it is the product of stroke volume and heart rate. Cardiac output increases with the intensity of the exercises.

The cardiac output in untrained individuals may be 14-20 l/min, in trained individuals 25-35 l/min and in the best athletes, the cardiac output can be upto 40 l/min at rest.

It is calculated according to the following formula
 $\text{Cardiac Output} = \text{Heart Rate} \times \text{Stroke Volume}$

7. **Quick Recovery** A healthy heart means quick recovery from the workout. The heart becomes normal quickly after vigorous exercises and also pumps more blood when required.

8. **Blood Pressure** During the exercise, systolic blood pressure (pressure against artery walls during heartbeats) can increase while diastolic blood pressure (pressure against artery wall while heart is resting) usually remains unchanged even during the intensive exercise.

9. **Decrease in Rate of Respiration** When a beginner

10. **Lung Volume** For normal breathing at rest, lung expand and there is a change in air pressure. During exercise, due to rapid movement of diaphragm and intercostal muscles, total area of lung expands to accommodate more exchange of gases.
11. **Tidal Volume** It is the amount of air inhaled by a person during a normal breath. It is around 500 ml per inhale for a healthy adult.
During exercise, this tidal volume increases. Depending on the intensity it may be 1500-2000 ml for ordinary person and for well-trained athlete, it may be increased to 2500 ml.
12. **Lung Diffusion Capacity** During exercise, the lung diffusion capacity increases in both trained and untrained persons. However, trained athletes may increase their diffusion capacity 30% more than that of an untrained person because athlete's lung surface area and red blood cell count is higher than that of non-athletes.
13. **Pulmonary Ventilation** The amount of air passing through lungs each minute is called Pulmonary Ventilation (PV). The PV is a product of Tidal Volume (TV) and Respiratory Rate (RR), and therefore at rest it is around 8 l/min.
During exercise time, both TV and RR increases, due to which PV will also increase depending on the intensity of exercise.
For ordinary person, the value of PV may be 40-50 l/min and for well-trained athlete, it may be around 100 l/min.
14. **Oxygen Uptake** It is the amount of O_2 that can be absorbed by the working muscles from the blood. It is also called VO_2 . The oxygen uptake increases due to exercises, thus providing the body with greater oxygen.
15. **Residual Air Volume** It is the volume of air in the lungs which is left after exhalation. With exercises, the residual air capacity increases which enhances efficiency of lungs.
16. **Vital Air Capacity** It is the sum of tidal volume, inspiratory reserve volume and expiratory reserve volume. It is the maximum amount of air a person can expel from the lungs after a maximum inhalation. This capacity rises with the increase in exercises and varies from 3500 cc to 4500 cc in a

Effects of Exercise on Muscular System

Muscular system plays a very significant role in the functioning of body. Exercise works as a stimulus and gives stress to muscles. It improves both strength and endurance of muscular system of an individual.

It involves a series of sustained muscle contractions, of either long or short duration, depending upon the nature of physical activity.

Following are the effects of exercise on the muscular system

1. **Increase in Muscle Temperature** Muscles are very inefficient and much of the energy we use to contract them is lost as heat. However, the increase in muscle temperature (between one to two degrees) during an exercise enables your muscles to be more flexible.
2. **Muscle Size** Although muscle size (and other physical characteristics such as height) is largely determined by a person's genes but muscle size also gets affected by the intensity of exercises. For example, in weightlifting, the diameter of the muscles increases.
3. **Increase in Lactate Threshold** Exercise increases the ability of the muscles to tolerate lactic acid. This increases endurance as the working capacity of the muscles rises due to delayed tiredness and fatigue.
4. **Muscle Coordination** Frequent exercise and special use of specific muscles for the same or similar skilled tasks, like dribbling a ball in a game of football, leads to improved coordination. The coordination of nerves to the skeletal muscles also improves.
5. **Muscle Biochemistry** Many beneficial biochemical changes take place in muscle tissues as a result of regular long-term exercises, such as increase in the size and quantity of mitochondria in the cells, increase in the activity of enzymes.
6. **Increase in Muscle Mass** Regular exercise and physical activities increase the muscle mass of a person, thus making him stronger, fitter, and healthier.

7. **Increases Alertness** Physical activity or exercise, in the short-term, can increase your alertness as hormones are released. These hormones can also help you to feel more relaxed after the activity.
8. **Delays Fatigue** Regular exercise delays the onset of fatigue as exercise develops the fitness levels and increases endurance thereby delaying fatigue.
9. **Helps in Maintaining Toned Muscles** Regular exercise helps in keeping the muscles in toned position. Muscles become firm and maintain a slight and a steady pull on the attachments.
10. **Helps You Control Your Weight** Along with diet, exercise plays an important role in controlling your weight and preventing obesity.
To maintain your weight, the calories you eat and drink must equal the energy you burn.
To lose weight, you must use more calories than you intake.
11. **Reduce Your Risk of Falls** For older adults, research shows that doing balance and muscle-strengthening activities in addition to moderate-intensity aerobic activity can help in reducing risk of falling.

Sports Injuries

A sports injury may be defined as “damage to the tissues of the body that occurs as a result of sport or exercise”.

They are commonly caused by overuse, direct impact, or the application of force that is greater than the force that a body part can structurally withstand.

There are two kinds of sports injuries *i.e.* *acute* and *chronic*. Acute injury is an injury that occurs suddenly, such as sprained ankle caused by an awkward landing while, chronic injury is caused by repeated overuse of muscle groups or joints. Poor technique and structural abnormalities can also contribute to the development of chronic injuries. Medical investigation of any sports injury is important, because the person may be hurt more severely than he/she thinks.

For example, what seems like an ankle sprain may actually be a bone fracture.

Along with giving best performance by a sportsperson, it is also important for them to prevent themselves from injuries. Proper conditioning should be done before taking part in sports competitions. The scientific

Classification of Sports Injuries

Sports injuries can be classified according to the type of tissues. They are

Soft Tissue Injuries

This type of injury includes damage of muscles, sprain, strain, abrasion, laceration etc. in which injury is caused on soft tissue of the skin, muscles, tendons, synovial membrane, fibrous tissue, fat, blood vessels, nerves and ligaments in body. For example, a sprained ankle. Soft tissue injuries occur more than hard tissue injuries.

These are explained as below

1. Abrasion

It is a shallow wound, typically a wearing away of the top layer of skin (the epidermis) due to an applied friction force against the body. It may be caused by falling on a hard surface.

The scraped-off surface layer of skin from an abrasion can contain particles of dust or dirt, which may lead to an infection or other complications, if not cleaned and attended properly. Abrasions are distinguished from incised wounds, which are much more serious injuries. While an abrasion is an injury that damages only the superficial layers of skin, incised wound is a deeper cut (typically with a sharp object), that has the potential for serious and severe bleeding.



Abrasion

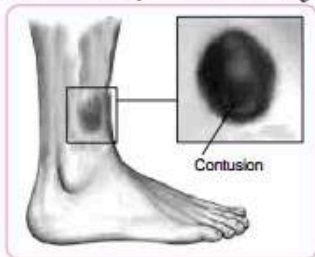
2. Contusion

Contusion is a muscle injury. It can be caused by a direct hit with any sports equipments. It generally happens when an injured capillary or blood vessel leaks blood into the surrounding area.

Stiffness and swelling are common features of contusion. Soft tissue contusions are much easier to diagnose than bone contusions because they have distinct characteristics like

- discoloured skin that looks red, green, purple, blue or black.
- a small bump over the area in some cases.
- pain that is usually worse when pressure is applied to the area.

While both muscle and skin tissue contusions cause pain, muscle tissue contusions are usually more painful, especially if they affect a muscle that you can't avoid using.



Contusion

3. Laceration

It is basically tearing of the skin that results in an irregular wound. Lacerations may be caused by injury with a sharp object or by impact injury from a blunt object or force. They may occur anywhere on the body.

In most cases, tissue injury is minimal, and infections are uncommon. Severe lacerations are often accompanied by significant bleeding and pain.

Cleaning and preparing a laceration for repair is crucial for preventing infection and reducing the appearance of scarring.



Laceration

4. Incision

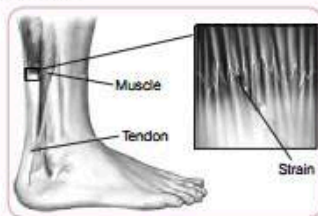
An incision wound is a cut in the skin caused by a sharp object such as a knife, broken glass, scissors, etc. However, occasionally these types of wounds can be very deep, cutting into muscle tissue, tendons or major blood vessels. Damage to major blood vessels can cause life-threatening bleeding.

Examples of incised wounds include

- Surgical incisions.
- Cuts to the skin due to accident.
- Cutting of your skin due to broken glass.

5. Strain

A strain is defined as an injury to a tendon (tissues that connect your muscles and bones) or muscle. Strains often occur in the lower back and the muscle in the back of the thigh.



Strain

Some of the symptoms include pain, swelling, muscle spasms and limited ability to move the muscle.

Contact sports like soccer, football, hockey, boxing and wrestling put people at risk for strains. Strain can happen as sudden (acute) strain or develop over days (chronic).

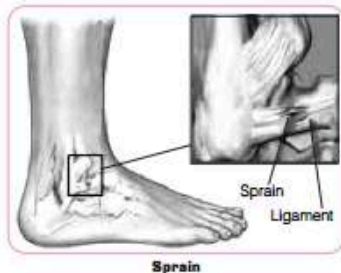
An acute strain is caused by trauma or an injury such as a blow to the body. It can also be caused by improperly lifting heavy objects or over-stressing the muscles. Chronic strains are usually the result of overuse prolonged, repetitive movements of muscles and tendons.

6. Sprain

A sprain is a stretch or tear of a ligament, a strong band of connective tissue that connects the end of one bone with another. Ligaments stabilise and support the body's

For example, ligaments in a knee connect your thigh bone (Femur) with your Shinbone (Tibia), enabling you to walk. The areas of the body that are most vulnerable to sprain are the ankles, knees and wrists. A sprained ankle can occur when your foot turns inward, placing extreme tension on the ligaments of your outer ankle.

A sprained knee can result from a sudden twist, and a wrist sprain can occur if you fall onto an out stretched hand. Sometimes, fracture is also possible along with the sprain. In such injury, pain, bruising, swelling and inflammation are common symptoms.



Hard Tissue Injuries/ Bone and Joint Injuries

The hard tissue injuries take place in bones and cartilages, e.g. a fracture. These injuries are also known as bone and joint injuries. The nature of the damage depends on the direction of the applied force on the bones and the manner in which these bones are attached to other structures.

This type of injuries are explained below

Bone Injury: Fracture

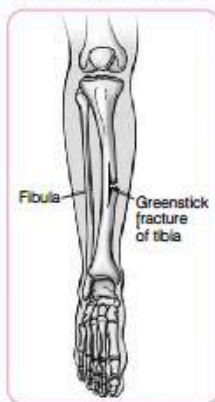
A hard tissue injury is also called a 'fracture' and is defined as a "loss of continuity in the substance of a bone".

In other words, it is a bone injury that breaks the continuity of bone or separate it into two or more parts. Fracture is of various types, which are as follows

1. Greenstick Fracture

A greenstick fracture occurs when a bone bends and cracks, instead of breaking completely into separate pieces.

Most greenstick fractures occur in children younger than 10 years of age because their bones are softer and more flexible than the bones of adults.



Greenstick Fracture

In this type of fracture, arm fractures are most common than leg fractures. It can be caused by many things like participation in sports, motor vehicle accidents and falls.

2. Comminuted Fracture

It is a break or splinter of the bone into more than two fragments.

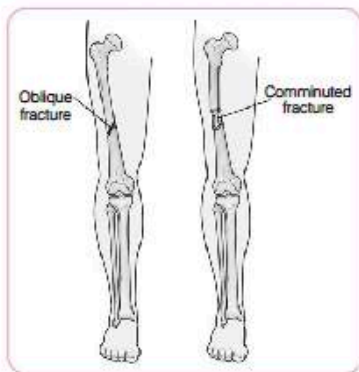
Since considerable force and energy is required to fragment bone, fractures of this kind occurs after high-impact trauma such as vehicular accidents.

This type of fracture is usually challenging to treat because the break is so complex.

3. Oblique Fracture

An oblique fracture is characterised by a break that is curved or at an diagonal angle to the bone. A sharp blow that comes from an angle (*i.e.* above or below) may cause oblique fractures.

They are particularly prone to angulation in the plane of the fracture. Trauma, sudden twist of the muscles or bone diseases may cause oblique fracture.



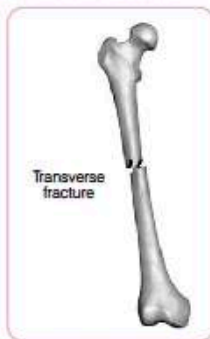
Oblique Fracture Comminuted Fracture

4. Transverse Fracture

It is a fracture where the bone breaks at a right angle to the long axis of the bone.

Transverse fractures most often occur as the result of strong force applied perpendicular to the long axis of a bone.

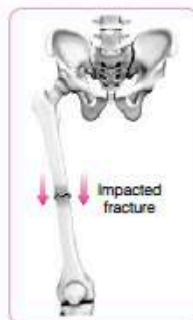
This may also be caused due to trauma, sudden twisting of the bone due to muscle spasm or indirect loss of leverage or by certain bone diseases.



Transverse Fracture

5. Impacted Fracture

An impacted fracture is one whose ends of cracked



Impacted Fracture

In other words, it is a fracture caused when bone fragments are driven into each other. Lifting overweight item is one of the main causing factors of this fracture.

Joint Injuries

Joint injuries typically occur in the knees, ankles, wrists, shoulders and elbows. They can range from sprains to fractures and dislocations.

A dislocation is a separation of two bones where they meet at a joint. A dislocated joint is a joint where the bones are no longer in their normal positions.

A dislocated joint may be accompanied by numbness or tingling at the joint or beyond it. It is intensely painful, especially if you try to use joint or put weight on it.

Some of the common joint dislocations are

1. Shoulder Dislocation

This occurs when the ball of the upper arm bone (humerus) pops out of the shoulder socket. It is usually caused by a fall on to the upper arm, or during contact sports such as Rugby. Usually, the dislocated ball pops out at the front of the shoulder joint, where the supporting muscles are at their weakest.



2. Elbow Dislocation

The elbow is the second most common dislocation in adults. It takes a lot of force to dislocate the elbow, which is often an associated break in one of the bones. Dislocated elbows are at high risk of trapping blood vessels and need urgent attention.

The most common cause is falling and landing on your outstretched hand or arm, pushing the forearm bone sideways out of the joint.

Sports like cycling, gymnastics, etc. tend to be the most common sports causing elbow dislocation.



Elbow Dislocation

3. Dislocated Finger

This is a common injury which can affect any finger joint but most commonly affects the middle knuckle of the four fingers (rather than the thumb).

It is usually caused either by over-bending the finger backwards or catching the finger somewhere during fast movement.

This happens during sports activities when player try to stop the fast balls with the hand.



Dislocated Finger

4. Wrist Dislocation

Wrist dislocation means dislocation of any of the eight small bones which make up the wrist. It is usually caused by a fall on the wrist or the outstretched arm. Symptoms include pain and obvious distortion of the wrist.

5. Ankle Dislocation

Dislocation of ankle joint is a rare injury but can happen in sports. It is more common when there is an ankle fracture at the same time, as that can make the ankle joint unstable.



Ankle Dislocation

CHAPTER PRACTICE

OBJECTIVE TYPE QUESTIONS

Multiple Choice Questions (MCQs)

- 1** Which factor of a person determines the range of motions and level of flexibility?
(a) Joint structure (b) Internal environment
(c) Age and gender (d) Previous injury
Ans (a) Joint structure
- 2** is a shallow wound, typically wearing away of the top layer of skin (the epidermis) due to an applied friction force against the body.
(a) Contusion (b) Abrasion
(c) Laceration (d) Incision
Ans (b) Abrasion
- 3** is defined as an injury to a tendon or muscle.
(a) Contusion (b) Incision
(c) Sprain (d) Strain
Ans (d) Strain
- 4** It is the fracture which occurs when a bone bends and cracks, instead of breaking completely into separate pieces.
(a) Transverse (b) Comminuted
(c) Green Stick (d) Impacted
Ans (c) Green Stick
- 5** Which of the following is not a beneficial effect on bio-chemistry due to exercise?
(a) Increase in size and quantity of mitochondria in muscle cells
(b) Better muscle coordination
(c) Increase in the activity of enzymes in muscles
(d) None of the above
Ans (b) Better muscle coordination
- 6** Sprain is an injury of the CBSE 2020
(a) Muscle (b) Ligament
(c) Joint (d) Bone
Ans (b) Ligament
- 7** Laceration is a CBSE 2020
(a) irregular cut on skin (b) tissue injury
- 8** The capacity of muscles to absorb and consume oxygen is called CBSE 2020
(a) Oxygen intake (b) Oxygen uptake
(c) Oxygen gain (d) Oxygen transfer
Ans (b) Oxygen uptake
- 9** Which one of the following is not a joint dislocation?
(a) Shoulder dislocation (b) Elbow dislocation
(c) Kneec dislocation
(d) Wrist dislocation
Ans (c) Kneec dislocation
- 10** Assertion (A) Flexibility is that quality of the muscles, ligaments and tendons that enables the joints of the body to move easily through a complete range of movement.
Reason (R) More flexibility of the joints reduces movement of limbs.
In the context of above two statements, which one of the following is correct?
Codes
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true, but R is not the correct explanation of A
(c) A is true, but R is false
(d) A is false, but R is true
Ans (c) A is true, but R is false
- Fill in the Blanks**
- 11** The muscle composition is and cannot be changed by training.
Ans genetical
- 12** The vital air capacity varies from to in a normal adult.
Ans 3500CC, 4500CC
- 13** Regular exercise delays the onset of as exercise develops the fitness levels and increases endurance.
Ans fatigue
- 14** There are two kinds of sports injuries that are and

15 are caused by injury from a blunt object or force.

Ans Lacerations

State True or False

16 The elbow is the second most common dislocation in adults.

Ans True

17 Dislocated joint is not intensely painful when you put weight on it.

Ans False. Dislocated joint is intensely painful when you put weight on it.

18 During exercise, the lung diffusion capacity increases in both trained and untrained persons.

Ans True

19 The persons containing more of red fibres will have greater speed.

Ans False. The persons containing more of white fibres (fast twitch fibres) will have greater speed.

Match the Following

20 List I (Components)	List II (Factors)
A. Strength	(i) Aerobic Capacity
B. Speed	(ii) Muscle Size
C. Flexibility	(iii) Explosive Strength
D. Endurance	(iv) Stretchability of Muscles

Codes

	A	B	C	D		A	B	C	D
(a)	(ii)	(iii)	(iv)	(i)	(b)	(i)	(ii)	(iii)	(iv)
(c)	(iv)	(ii)	(i)	(iii)	(d)	(iii)	(i)	(ii)	(iv)

Ans (a)

21 List I (Types of Fracture)	List II (Meaning)
A. Oblique fracture	(i) Bone breaks at a right angle.
B. Transverse fracture	(ii) Splinter of bone into more than two fragments.
C. Greenstick fracture	(iii) Bone bends and cracks.
D. Comminuted fracture	(iv) Bone breaks at a diagonal angle.

Codes

© VERY SHORT ANSWER TYPE QUESTIONS

22 Define physiology.

Ans Physiology is defined as the branch of science that deals with the functioning of the organs and their relationships with other organ systems to maintain functioning of human body.

23 Why physiology is important in sports?

Ans Physiology is essential to understand how to attain physical fitness in order to enhance the performance in sports by improving the functions of the body.

24 Why does involvement in regular exercise delay the onset of fatigue? All India 2015

Ans Regular exercise delays the onset of fatigue as exercise develops the fitness levels and increases endurance thereby delaying fatigue.

25 List any four changes happening in the muscular system due to exercising.

CBSE SQP 2021 Term II

Ans Changes happening in the muscular system due to exercising are

- Change in size and shape of muscle.
- Increase in the strength of muscles.
- Increase in coordination.
- Entrance of greater quantity of oxygen in the body.

26 Calculate how much blood is pumped by the heart of a normal untrained male in one minute. All India 2015

Ans Blood pumped by the heart in one minute is
 Cardiac Output = Heart Rate \times Stroke Volume.
 Heart rate per minute = 72 beats
 Stroke volume in normal untrained male = 70 mL/beat
 Cardiac Output = $72 \times 70 = 5040$ mL/m

27 What is stroke volume? All India 2016

Ans The volume of blood pumped into the heart with every heartbeat is known as the stroke volume. In an untrained male, it is 50 to 70 mL/beat.

28 What is oxygen uptake? All India 2017

- 29** Which type of sports injury is known as 'strain'? CBSE 2019
- Ans** A strain is defined as an injury to a tendon or muscle. It often occurs in lower back and in thighs.
- 30** What do you mean by soft tissue injuries? CBSE 2019
- Ans** This type of injury is the damage of muscles, sprain, strain, abrasion, laceration, etc. in which it is caused on soft tissue of the skin muscles, tendons, ligaments, etc. in the body.
- 31** What kind of sports injury can be termed as abrasion? All India 2016
- Ans** An abrasion is a wound caused when the skin is scraped or rubbed in the epidermis (upper layer of the skin) known as a soft tissue injury.
- 32** What is incision? All India 2017
- Ans** An incision is a cut or a wound produced by cutting with a scalpel. In sports, incision refers to a type of cut in which the skin cuts with clean edges i.e. a regular straight cut of the skin.
- 33** Mention the various types of soft tissue injuries.
- Ans** The injuries to muscle, ligament, tendon and skin are soft tissue injuries such as strain, sprain, abrasion etc.
- 34** What do you understand by dislocation of joint?
- Ans** Dislocation of joint means abnormal separation in the joints where two or more bones meet. They are caused by trauma on the joint by an impact or fall.
- 35** Mention different types of fractures.
- Ans** Different types of fractures are greenstick fracture, comminuted fracture, transverse fracture, oblique fracture and impacted fracture.
- 36** Explain the meaning of cardiac output. CBSE 2018
- Ans** Cardiac output is the term that describes the amount of blood your heart pumps each minute.
- 37** What type of sports injury can be termed as 'Laceration' in sports? CBSE 2018
- Ans** Laceration is an irregular cut on the skin with

C SHORT ANSWER TYPE QUESTIONS

- 38** Why men can do more vigorous exercises and for a longer duration than women?
- Ans** Men have greater muscle mass than women. Their heart is slightly larger and heartbeat slower due to which they have greater capacity to distribute blood in the body. This improves their cardiovascular functions which enables them to do vigorous exercises. The endurance level of men is also high because of high haemoglobin content and better blood circulation. Therefore, men can do exercise for a longer duration than women.
- 39** Discuss the different factors that determine strength as a component of physical fitness.
- Ans** The factors determining strength as a component of physical fitness are
- (i) **Size of the Muscle** The size of the muscle determines the strength possessed by an individual. Males have bigger and larger muscles due to which they have more strength than females.
 - (ii) **Muscle Composition** Muscles consist of two types of fibres i.e. fast twitch fibres (white fibres) and slow twitch fibres (red fibres). The fast twitch fibres are capable to contract faster and therefore they can produce more force. On the contrary, the slow twitch fibres are not capable to contract faster but they are capable to control for a longer duration. Muscles containing more percentage of fast twitch fibres produce more strength. The percentage of fast and slow twitch fibres is genetically determined and cannot be changed through training.
 - (iii) **Intensity of the Nerve Impulse** A muscle consists of many motor units. The number of contracting motor units determines the total force. If muscles contract with greater intensity then more strength will be produced.
- 40** Discuss the physiological factors determining flexibility.
- Ans** The physiological factors determining flexibility are as follows
- (i) **Joint Structure** The joint structure of a person determines the range of motions and

For example, the ball and socket joint of the shoulder has the greatest range of motion in comparison to the knee joint.

- (ii) **Age and Gender** The age of a person as well as the gender determines the level of flexibility. It can be enhanced with the help of training as strength and endurance are enhanced. Flexibility decreases with advancement of age and females are more flexible than males.
- (iii) **Stretchability of Muscles** If the muscles are regularly stretched, then they remain flexible. The stretchability of muscles depends on the amount of exercises and physical activities.

41 Discuss three effects of exercise on the muscular system of our body.

Ans The effects of exercise on the muscular system are as follows

- (i) **Increase in Lactate Threshold Exercise** increases the ability of the muscles to tolerate lactic acid. This increases endurance as the working capacity of the muscles rises and muscles work for longer duration without fatigue.
- (ii) **Increase in Muscle Mass** Regular exercise and physical activities increase the muscle mass of a person thus making him stronger, fitter and healthier.
- (iii) **Muscle Coordination** Frequent exercise and special use of specific muscles for the same or similar skilled tasks, like dribbling a ball in a game of football leads to improved coordination. The coordination of nerves to the skeletal muscles also improves.

42 Explain briefly strain and sprain.

Ans Strain and sprain are two common soft tissue injuries. Strain is caused due to twist, pull or tear of the muscles or tendons with symptoms of pain, swelling and loss of muscle strength. On the other hand, sprain is a partial or complete tear of a ligament with symptoms of pain, swelling, bruising, loss of function. Both are caused due to weak muscular systems or insufficient warming up.

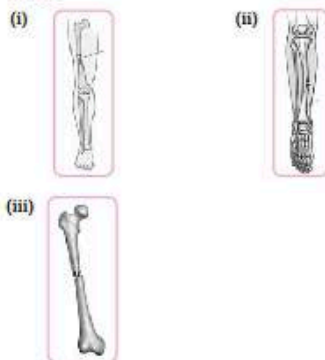
43 What do you understand by fracture? Explain two first aid techniques for fractures.

Ans Fracture is a bone injury that breaks the

The first aid techniques for fractures are as follows

- Immediately immobilise the injured area. Do not try to re-align the bone or push back in a bone that may be sticking out.
- Apply ice packs to limit swelling and help relieve pain until medical help arrives.

44 Identify the bone fracture and give their name



- Ans** (i) Comminuted Fracture
 (ii) Greenstick Fracture
 (iii) Transverse Fracture

45 Early morning, we observe many older people following fitness regime. One day Ramu observed a 60-year-old man was holding his chest on the ground. When Ramu approached him, he said that he felt chest pain regularly after jogging.

- (i) What is the rate of normal heart beat of an adult?
 (a) 72 (b) 80 (c) 65 (d) 90
- (ii) Age and gender play a very important role in which of these components?
 (a) Endurance
 (b) Strength
 (c) Explosive Strength
 (d) Speed
- (iii) Muscular strength starts receding during the age of
 (a) 25-30 years (b) 35-40 years
 (c) 45-50 years (d) 50-55 years

46 Mr. Raghav, aged 45 years was advised by his doctor to exercise regularly and take care of his dietary habits. This advice was given keeping in view his advancing age and sedentary working profile. Considering his lifestyle answer the following questions.

- (i) The most commonly seen change in the cardiovascular system due to regular exercise is
(a) ↑ BP (b) ↓ Pulse rate
(c) Both (a) and (b) (d) No change
- (ii) Due to regular exercising, the viscosity of the blood
(a) increases (b) decreases
(c) remains same (d) Both (a) and (b)
- (iii) The changes in the chemical composition of blood due to exercises are
(a) RBC increases
(b) Plasma increases
(c) Platelets increases
(d) All of the above

Ans (i) (a) ↑ BP (ii) (a) increases
(iii) (d) All of the above

© LONG ANSWER TYPE QUESTIONS

47 What are the various factors affecting physiological fitness? Explain.

All India 2015

Or Discuss the physiological factors determining components of physical fitness.

Delhi 2015

Ans Physiological factors determining components of physical fitness are

- (i) **Muscular Strength** This is the maximum force or tension a muscle or a muscle group can exert against a resistance. Physiologically, the muscle will increase in strength only if it has to increase its workload beyond what is ordinarily required of it.
- (ii) **Speed** This is the rapidity with which one can repeat successive movements of the same pattern. Individuals with greater speed have superior reaction time.

period of time with less discomfort and more rapid recovery.

- (iv) **Flexibility** This is a quality of the muscles, ligaments and tendons that enables the joints of the body to move easily through a complete range of movement.

48 Discuss the factors determining speed.

Ans The factors determining speed are discussed below

- (i) **Bio-chemical Reserves and Metabolic Power** For maximum speed performance, the muscles require more amount of energy at a very high rate of consumption. For this work, the phosphogen Adenosine Triphosphate (ATP) and Creatine Phosphate (CP) stores in the muscles should be enough.

If ATP and CP store is less in contracting muscles, the muscle contractions due to insufficient energy supply become slow after a short time.

The metabolic power depends upon the energy supplied through certain enzymes. Proper working of the enzymes means high rate of metabolism which increases speed of doing work.

- (ii) **Muscle Composition** Muscles consist of two types of fibres *i.e.* fast twitch fibres (white fibres) and slow twitch fibres (red fibres). A person containing more of fast twitch fibres will have greater speed.

- (iii) **Mobility of the Nervous System** The rapid contraction and relaxation of the muscles takes place due to rapid excitation of the nervous system. The rapid movements give greater speed.

The nervous system can maintain this rapid excitation and inhibition only for a few seconds after which the excitation spreads to the neighbouring centres causing tension in the entire body. This results in decrease in speed.

49 What are the effects of exercising on the cardiorespiratory system? Explain. CBSE 2020

Or A trainer can improve the cardiorespiratory system with the help of exercise. Justify this statement.

Ans The cardiorespiratory system consists of organs responsible for taking in oxygen for respiration and releasing carbon dioxide and water vapour.

A trainer can improve the cardiorespiratory system with the help of exercise by

- (i) **Decrease in Rate of Respiration** When a beginner starts exercise, then his rate of respiration increases. But when the same individual performs exercise daily, then his rate of respiration decreases in comparison to the beginning stage at rest.
- (ii) **Lung Volume** For normal breathing at rest, lung expand and there is a change in air pressure. During exercise, due to rapid movement of diaphragm and intercostal muscles, total area of lung expands to accommodate more exchange of gases.
- (iii) **Lung Diffusion Capacity** During exercise, the lung diffusion capacity increases in both trained and untrained persons. However, trained athletes may increase their diffusion capacity 30% more than that of an untrained person because athlete's lung surface area and red blood cell count is higher than that of non-athletes.
- (iv) **Pulmonary Ventilation** The amount of air passing through lungs each minute is called Pulmonary Ventilation. The Pulmonary Ventilation (PV) is a product of Tidal Volume (TV) and Respiratory Rate (RR) and therefore at rest it is around 8 l/min. During exercise time both TV and RR increase, due to which PV will also increase depending on the intensity of exercise. For an ordinary person, the value of PV may be 40-50 l/min and for well trained athlete, it may be around 100 l/min.
- (v) **Residual Air Volume** It is the volume of air in the lungs which is left after exhalation. With exercises, the residual air capacity increases which enhances efficiency of lungs.

50 What do you understand by fracture? How can fractures be classified? Explain.

Ans Fracture is defined as a loss of continuity in the substance of a bone. It is simply a break in the bone. It commonly happens because of accident, fall, or sport injuries. It is classified into different types, which are discussed below

1. **Greenstick Fracture** A greenstick fracture occurs when a bone bends and cracks,

bones are softer and more flexible than are the bones of adults.

2. **Comminuted Fracture** It is a break or splinter of the bone into more than two fragments. Since considerable force and energy is required to fragment bone, fractures of this kind occurs after high-impact trauma such as vehicular accidents. This type of fracture is usually challenging to treat because the break is so complex.
3. **Transverse Fracture** It is a fracture where the bone breaks at a right angle to the long axis of the bone. Transverse fractures most often occur as the result of strong force applied perpendicular to the long axis of a bone.
4. **Oblique Fracture** An oblique fracture is characterized by a break that is curved or at an angle to the bone. A sharp blow that comes from an angle (i.e., above or below) may cause oblique fractures.
5. **Impacted Fracture** An impacted fracture is one whose ends are driven into each other. This commonly occurs with arm fractures in children and is sometimes known as a buckle fracture.

51 Write in detail about the dislocation and fractures among the bones and joint injuries. All India 2016

Ans The dislocation and fractures among the bones and joints happen when excessive force is applied directly or indirectly. These are musculoskeletal injuries and can be grouped under hard tissue injury.

A dislocation refers to displacement or separation of bones from the joint. It is caused by a sudden impact, a trauma or a fall.

A dislocated joint may be accompanied by numbness or tingling at the joint or beyond it. It is intensely painful, especially if you try to use joints or put weight on it.

Some of the common joint injuries are shoulder dislocation, knee cap dislocation, finger dislocation etc. A fracture is a break in the continuity of a bone or a separation of a bone in two or more parts. It is caused when greater force is exerted against a bone than it can

SELF ASSESSMENT

OBJECTIVE ANSWER TYPE QUESTIONS

- Explosive strength is determining factor of
(a) Speed (b) Endurance (c) Muscular strength (d) Flexibility
- What is average stroke volume of a trained male?
(a) 50-60 ml/beat (b) 70-90 ml/beat (c) 90-110 ml/beat (d) 30-40 ml/beat
- is a shallow wound, typically wearing away of the top layer of skin (the epidermis) due to applied friction force against the body.
(a) Contusion (b) Abrasion (c) Laceration (d) Incision
- is a cut in the skin caused by sharp object such as knife, broken glass, etc.
(a) Abrasion (b) Sprain (c) Laceration (d) Incision
- The vital air capacity varies from to in a normal adult.
- An fracture is one whose ends of cracked bones are driven into each other.
- During exercise, the lung diffusion capacity increases in both trained and untrained persons. State true or false.
- Warm-up plays significant role in the prevention of sports injuries. State true or false.

VERY SHORT ANSWER TYPE QUESTIONS

- Why males have greater tolerance than females?
- What do you understand by cardiac output?
- What is the advantage of having a high lactic acid tolerance in the muscles?
- List any four common injuries in sports.

SHORT ANSWER TYPE QUESTIONS

- What is aerobic capacity? What are the factors that influence it?
- Explain the factors that affect the physical fitness component of endurance.

LONG ANSWER TYPE QUESTIONS

- Why elderly people are prone to bone injuries? How doing exercise can help them?
- Explain the muscle composition. How the composition is responsible for strength and endurance?
- Classify the sports injuries based on tissue type injured.