BLOCK 3
FACTORS AFFECTING PHYSICAL PERFORMANCE

UNIT 9 PRINCIPLES OF PHYSICAL CONDITIONING TECHNIQUES*

Contents

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LEARNING OBJECTIVES

After going through this unit, you will:

- learn the benefits of physical activity;
- know what is physical fitness and its importance;
- understand how physical conditioning programs be designed;
- identify the types of training methods and their uses; and
- gain knowledge of yoga and use of yoga for fitness.

9.0 INTRODUCTION

Physical fitness refers to the overall individual physical condition. Physical fitness is of great importance for all human beings irrespective of age. A person may not be able to perform a particular task if he lacks required physical strength. It is different for each person and can range from extreme illness and near death, to peak performance, like top Olympic and decorated athletes. Modernisation and urbanisation have led to a reduction in physical activity of both men and women and dependence on modern gadgets has increased.

For a good performance in any sport, whether it is lacrosse, tennis, football, taekwondo, track and field, basketball or anything in between, achievement of a high standard of fitness is a basic requirement. Just the participation in sports is not enough to improve fitness, because fitness must be gained only through conditioning programmes. Fitness becomes even more important in competitive sports.

The American Alliance for Health, Physical Education and Recreation (AAPHER) has defined physical fitness as:

- Fitness is that state, which characterises the degree to which a person is able to function,
- Fitness is an individual matter. It implies the ability of each person to live most efficiently with his potential, and
- Ability to function depends upon physical, mental, emotional, social and spiritual components of fitness, all of which is related to each other and is naturally interdependent (Gorden, 1985).

Habits and attitudes towards physical activity developed during childhood are assumed to continue through adolescence into adulthood. Physical fitness is a related construct and it is also often assumed that the more habitually active are more fit (Malina, 1996).

Physical activity is related to the bodily movements that are produced by skeletal muscles resulting in energy expenditure whereas physical fitness is set of attributes that someone has or achieves. The components of physical fitness which can be measured are related to health and to skills pertaining to athletic ability.

9.1 IMPORTANCE OF FITNESS

A player in good physical condition is generally thought to have the ability to do sustained work. For a good performance in any sport or athletic event, achievement of a high standard of fitness is a basic requirement which must be gained only through conditioning programmes.

Evidence is mounting that physically fit persons lead longer lives, have better performance records than those who are unfit. A totally fit individual has strength, speed, endurance, power, agility and social and emotional adjustments appropriate to his life.

9.1.1 Physical Fitness

Physical fitness is the ability to carry out the daily task with vigour and alertness, without undue fatigue and with ample energy to enjoy the leisure time and pursuits to meet unforeseen emergency situations. Physical fitness is a broad term which literally means a hale and healthy physique. The physical level of an individual indicates as to how one fits into a group. The purpose of physical fitness is to create a consciousness and enthusiasm among people and to stimulate these interests for physical welfare which will help them to have a better and more healthful living (Bucher et al., 1985).

Physical fitness means the ability of an individual to live a happy and well balanced life. It involves not only physical, but intellectual, emotional, social and spiritual aspects of an individual. Interaction and interdependence of these phases of a man's health are such that any deviation from normal in any aspect of these components of fitness will make a man unable to meet the demands placed on him by his work or way of life.

Physical fitness includes speed, flexibility, power, strength, co-ordination, muscular endurance, cardiovascular endurance and agility. These characteristics are all equalised with the healthy functioning of the body. Another, but a different and important component of physical fitness is the athletic skill. The various aspects of physical fitness and the skills are inter-related. Physical fitness is a broad term denoting dynamic qualities that will satisfy the needs regarding mental and emotional stability. Social consciousness and adaptability, spiritual and mental fear and organic health are consistent with heredity. Physical fitness means that organic system of the body is healthy and it functions efficiently so as to enable the fit persons to engage in vigorous task and leisure activities beyond organic development, muscular strength, and endurance (Waynel et al., 1949).

Physical fitness implies efficient performance in exercise. Physical fitness is a term used to refer to the functional capacity of an individual to perform certain kinds of tasks requiring muscular activity. Physical fitness is the ability of the body to adopt and recover from strenuous exercise. It is the relation of one's ability to work and play with vigour and pleasure without undue fatigue and with sufficient energy for unforeseen emergencies. Physical fitness is the ability to last, to bear up and to persevere under difficult circumstances where an unfit person would give up. It is the opposite of being fatigued from ordinary efforts (Fleishman, 1985).

Check Your Progress 1

1) What do you understand by physical fitness?

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9.1.1.1 Importance of Physical Fitness

Every individual must know the importance of physical fitness. In other words one must have a fundamental knowledge of anatomy and physiology. This fundamental knowledge enables a person to understand physical fitness that it is the capacity of a person to function steadily and smoothly when a situation arises. Physical fitness makes one feel mentally sharper, physically more comfortable with the body and better able to cope with the demands that every day life makes upon us. Increased physical fitness not only improves health but improves our performance at work. Hundreds of American companies have backed this idea financially by employing full time directors of fitness for the work. It is necessary for every individual to be physically fit to perform their daily work with ease and to take part in various activities effectively. Everyone should be fit enough through participation in physical activities to develop the different physical fitness components. In the day-to-day living, physical health and nutrition appear to have gained a place of priority.

Through physical activity, physical fitness is built and maintained. If one has improved his physical fitness, it can be presumed that he has improved the efficiency of his heart and lungs. Let us enlist few other benefits of physical activity that lead to physical fitness, these are: the delay in aging process, protection of lower back problems, maintenance of body weight, reduction in the rate of incidence of heart diseases and the reduction in reliance on drugs that induce sleep.

Physical fitness plays a vital role in any performance. An individual's physical fitness and performance depends upon the coordinated functioning of the various factors such as physical, psychological abilities, nutrition, technique tactics, physique, body size and composition. Thus physical fitness plays a vital role in all the results of many athletic events and games.

9.1.1.2 Physical Activity Components of Physical Fitness

Physical fitness is more than just how fast you can run or how many pull-ups you can do. It is more than just how good you are at running ladders, or how long you can squat. Physical fitness is holistic. Physical fitness encompasses several areas, including:

- Agility

- Endurance
- Power
- Speed
- Strength
- Co-ordination
- Dexterity
- Flexibility

A good physical conditioning routine will include exercises that work on each of these areas. Working on one more than another can cause an imbalance, therefore causing injuries and decreased performance.

Check Your Progress 2

2) What are the components of physical fitness?

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3) How flexibility can benefit athletes?

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9.1.2 Physical Fitness Variables

The components of physical fitness variables for a particular study may include shoulder strength, abdominal strength, speed, power, agility and endurance to analyse the physical fitness variables and the influence of physical exercises, circuit training and yogic practice on the physical fitness variables.

9.1.2.1 Importance of Shoulder Strength

Strength is the amount of force that can be exerted by a particular muscle. In athletic events, putting the shot has been selected for the shoulder strength. In shot-put one can see the combination of both strength and power. The importance of selecting shot-put is to reveal the shoulder strength of an athlete.

Strength is a conditional ability that is, it depends largely on the energy liberation processes in the muscles. Strength is also perhaps the most important motor ability in sports as it is a direct product of muscle contractions. All movements in sports are caused by muscle contractions and therefore, strength is a part and parcel of all motor abilities, technical skills and tactical actions. Strength and strength training therefore, assume high importance for achieving good performance in all sports.

Strength is the ability to overcome resistance or to act against resistance. Strength should not be considered a product of only muscular contractions. It is, in fact, a product of voluntary muscle contractions caused by the neuro-muscular system. In sports, depending on the nature of the movements the strength abilities can appear in complex form.

In weight lifting and throws the strength required is a combination of maximum strength and explosive strength. This combination is also known as power. In volleyball explosive strength appears in combination with strength endurance and is popularly referred to as power endurance.

9.1.2.2 Importance of Abdominal Strength

The abdominal muscles and oblique muscles that flex and twist the trunk respectively are referred to as the mid section muscles. Although most mid section exercise involve hip flexion, this is not really a function of the mid section muscles. Hip flexion is actually performed by the quadriceps and the underlying ileopsoas and pectineus muscles. Because traditional sit-ups involve both trunk flexion and hip flexion, the abdominals are the prime mover muscle group for the first phase of the movement but the hip flexors are response for the second phase of the movement. While there is nothing wrong with exercise that combine trunk flexion and hip flexion, specialised movements will be presented for those people who prefer to train the mid section muscles independently. The tightened abdominal muscles help to produce a streamlined appearance. A sit up is basically an exercise for the lowerback but it also brings abdominal muscles into action. Since it is difficult to isolate these muscles with a particular movement sitting up is commonly used to strengthen the abdominal wall. The abdominal strength is very much useful in the field of sports and games. When an individual possesses a high degree of abdominal strength he will be able to perform better any type of activity such as running, jumping, and throwing.

The physical educationist also should possess a very good abdominal strength as they are fully engaged in the field in various types of activities and to perform certain level they need to possess the abdominal strength. The abdominal strength helps to maintain the body posture thereby involving in many activities in the field of sports and games. Lifting a load or moving an inanimate or animate object essentially depends on the abdominal muscular strength (Waynel, 1949).

9.1.2.3 Importance of Power

Power is another variable chosen for the study. Performance in standing broad jump reveals the explosive power of an individual. Need of power in

standing broad jump is highly essential in relation to the energy used in jumping, sprinting, kicking, etc. The strengthening exercise like weight training, running up hill at speed, etc. will give explosive power. Explosive power is the ability to release maximum muscular force in the shortest time as in executing a standing broad jump. The explosive power measurement is expressed in terms of the distance through which the body or an object is propelled through space. The standing broad jump includes projecting the body into air. The main propulsive force comes from the legs in standing broad jump. Leg explosive power is most important for field events like standing broad jump, running broad jump and high jump (Dietrich, 1982).

9.1.2.4 Importance of Agility

"Agility may be explained as the physical ability which enables an individual rapidly change body position and direction in a precise manner". Agility plays an important role in physical activities especially in such events as gymnastics, basketball, pole-vaulting and some other major games. It is revealed to a great extent in sports involving efficient footwork and quick changes in body position. Agility is more effective when it is combined with high levels of strength endurance and speed. In any physical activity or in a game situation, the controlled ability to stop, to start and to change direction rapidly and more quickly, is a very essential factor and this quality decides one's performance level and the speed of acquiring any skill. The absence of that ability among the participants would spoil the original game score (Baumgartner and Jackson, 1987).

9.1.2.5 Importance of Speed

Speed, another variable chosen, is the capacity of the individual to perform in 100 Mts. sprint running a short distance at as much peak speed as possible. Therefore to measure the speed 100 Mts. sprint is selected. Speed of movement and quick reactions are praised quality in athletics. Coaches are frequently heard to praise certain players or an entire team for their quickness. In football a player who is extremely fast poses a constant threat to the opponents. In baseball the fast runner causes hurried throws and adjustments in pitching and defensive strategy, the full court press is a potent weapon in basketball, if the team has the speed.

Speed is the capacity of the individual to perform successive movement of the same pattern of fast rate. Speed is defined as the ability to move the entire body rapidly from one place to another (Conolly and Einzeing, 1986). Even though speed and reactions time are somewhat related, they are distinct characteristics and it is possible for people to be lacking one of the traits and still have an abundance of the others. There are different forms of speed:

i) Speed of every movement of body segments,

ii) Running speed for a very short distance (acceleration rate), and

iii) Maximum Running Speed (Hardayal Singh, 1991).

Speed is a determining factor in the explosive sports such as sprints, jumps and most field sports. However, despite these common place observations the

study of speed of movement, speed of reaction is much more complex than it might appear. Speed of movement for example entails much more than mere running speed. The speed with which a wrestler execute a reversal, the lighting flash of a boxer's job, the explosive spring of the shot putters move across the throwing circles, the swimmers and skater are but a few of the many different kinds of movement speeds that are involved in physical performance. Speed of movement shall thus be defined as the rate at which a person can propel his body or parts of his body through space.

9.1.2.6 Importance of Endurance

Endurance is another variable chosen for the study. Endurance is a very important ability in sports. But at the same time, it is an ability the importance of which is often overlooked in several sports. Endurance is the product of all psychic and physical organs and systems. Endurance is a conditional ability. It is primarily determined by energy liberation processes.

The ability of the human body to maintain a certain level of energy production forms the biological basis of endurance. Endurance is directly or indirectly of high importance in all sports. Endurance is the ability to do sports movements, with the desired quality and speed, under conditions of fatigue. In sports, endurance ensures optimum speed of motor actions. The ability to maintain pace or tempo of an exercise or during a competition is impossible without the requisite level of endurance. In sports, endurance ensures optimum speed of motor actions. The ability to maintain pace or tempo of an exercise or during a competition is impossible without the requisite level of endurance. Endurance training results in the improvement of functioning of various organs and systems of the human body. Endurance activities have been found to be high value for maintenance of good organic health, for increasing the general resistance against infection and for cure and treatment of various diseases and metabolic disorders. Endurance represents the capacity of the athlete for continuous performance of relatively heavy localized activity which may make only small demands on the functions of respiration and circulation before exhaustion set in. The more often a muscle performs a movement in training, over the same range, against the same resistance, and at the same frequency and speed as required in competition, then the less likely it becomes locally fatigued by that movement during competition. The improvement is primarily due to the functional involvement of more muscle fibres (motor units) as a result of overload. Overload also improves the utilisation of oxygen by involving more capillaries, thus providing the working muscles with more oxygen and as well as facilitating the removal of the metabolic waste products of strenuous exercise. General endurance is the ability to do sports movements of general nature under conditions of fatigue. General endurance is not specific to any sports and is developed through general exercises.

9.1.3 Exercise and Fitness

In physical exercise, muscles and limbs of the body and body powers are exerted. The main aim of this exertion will be either to maintain the health or to improve the health. All systematic training programmes have originated

from physical exercises. People, invariably, are interested in keeping good physical fitness and thus health, but try to opt for shot-cut methods. The word exercise refers to be conscious and purposeful physical activity, usually if sufficient intensity to increase to some degree of respiratory and circulatory function. It refers only the actual movement process at the time it occurs and should not be confused with the conditioning or training.

In the course of physical exertion a number of coordinated and compensatory adjustments takes place throughout the body which involve metabolic functions and the nervous muscular, circulatory and respiratory systems. Exercise ensures better digestion, respiration and efficient blood circulation. It has been suggested that the improved strength balance flexibility results from participation in exercise programme.

The purpose of exercise is to increase the circulation of blood and intake of oxygen. Experts in the field of physical education believe that regular physical activity helps to improve the strength and functioning of heart, lung and muscles. Exercise helps to clear the mind and makes for greater alertness and faster reaction time (Hazeldine, 1987). Exercise is needed all years long. For proper functioning the human organism needs exercise as an essential ingredient on a regular basis just as it demands nutritious food.

Regular exercises produce increased strength, endurance and other characteristics associated with good health, physical fitness is not an end in itself but means to an end. Though physical fitness is not health, they are very closely related. There is no physical fitness without health and there is no health without physical fitness. Fitness differs from being healthy. Health is defined generally as the freedom from a disease. Fitness relates to the ability to meet the demands of the environment (Hazeldine, 1987).

Exercise is needed all years long. For proper functioning the human organism needs exercise as an essential ingredient on a regular basis just as it demands nutritious food.

Check Your Progress 3

4) What are the benefits of Physical Activity?

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5) What types of energy systems are present in the body?

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9.2 IMPORTANT ASPECTS OF PHYSICAL CONDITIONING

The first step for improving fitness or sports performance through physical conditioning is to design a program with the goals and needs of the sport in mind. Not every sport or form of exercise requires each component of physical conditioning in equal proportion, if at all. The training programs of a sprinter differ significantly from those of a long-distance runner, for example. Training program should always be conducted with the help of a strength and conditioning specialist so as to increase performance and reduce the chance of injury. Programs based on the specific needs of the athletes can be developed based on the fitness, strength, and endurance of athletes. Conditioning programs also involve cross-training using various sports or exercises to improve overall performance. Cross-training creates different physical stresses on the athlete's body than those associated with the athlete's usual routine, improving the athlete's overall performance and also decreasing the risk of suffering an over use injury.

9.2.1 Important Aspects to be kept in Mind while Designing Conditioning Programs

The important aspects to be kept in mind while designing conditioning programs are:

- Training programs should always be designed with an end goal in mind. For instance, a runner planning to run a marathon should allow enough time to properly accelerate the training to have the body ready for the race date. Trying to achieve the goal too quickly might force the runner to increase distance running too rapidly and increase the risk for an overuse injury such as a stress fracture. Athletes should also consider adding exercise or resistance programs that differ from their normal routines. This variability not only can improve strength, power, agility, or other fitness areas they might lack, but also can decrease the repetitive stress they apply to the one or two body parts that their maintenance program applies. For instance, swimmer training for an upcoming meet might benefit from a long run once a week to decrease stress on shoulder.

- Athletes who use conditioning to lose weight need to ensure that they are eating enough calories and obtaining the proper vitamins, minerals, fluids, and supplements to meet their training needs. Athletes should consider consulting a sports nutritionist for guidance. In addition, getting enough sleep and rest between exercise sessions may help to optimise performance.

- Before starting any exercise or fitness program, athletes should consult with their medical doctor or a sports medicine physician. School or team athletes often undergo pre-participation physicals where any concerns can be addressed. Athletes recovering from surgery or an injury should ask the treating physician or physical therapist how to safely work back into sports. Anyone with an underlying medical condition should always

make sure that it does not pose too high a risk with a certain exercise program. Athletes should never avoid going to the doctor to address aches and pains for fear of being told to stop training. Athletes should consult with a sports medicine specialist.

Check Your Progress 4

6) What should be kept in mind while designing a physical conditioning program?

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9.3 TRAINING

"Training is a systematic process of repetitive, progressive exercise or work involving also, learning process and acclimatisation". Sports training is the physical, technical, intellectual, psychological and moral preparation of an athlete by means of physical exercise (Harre, 1982).

Training means preparing for something. It maybe an event, a season or athletic competition, a nursing career, an operatic performance or military combat. Much growth and change occur during training. It usually involves learning or polishing skills, changing attitudes, developing and strengthening organs and their functions when training is given, the sportsperson has something in mind, that is, a goal, a level of competence, a performance of some kind. An aspiration is established in the person's mind which is systematically pursued. The subject is preparing to meet increased demands of some kind on the current mental and physical resources. They seek in some way to change and better the present status to improve on the previous level of performance.

Without competition, training is meaningless. Today sport training is mostly based upon the competitive motive. Each nation is trying to achieve top level of performance and to win the international competitions. Today's records are proved to be lower to be performance of tomorrow. This is because greater stress has been given on the quality rather than quantity of training (Hazeldine, 1987).

9.3.1 Meaning of Training

Training means a systematic scientific programme of conditioning exercises and physical activities designed to improve the physical fitness and skills of the players or athletes participated. Training as mentioned earlier, means preparing for something like an event, a season of athletic competition, a nursing career or operative performance of militancy combat. Much growth and change occur during training.

9.3.2 Importance of Training

Training is done over an extended period of time to achieve training goals. Training may affect the psychological, emotional and physical status. It is usually intended to produce positive or desirable change. Training results in muscle fibre thickening (Greenberg and Pargman, 1989).

Training involves periodic assessment of the athlete's status and progress. Training usually varies regular increase in the difficulty of task performance. Training suggests some form of gradual increase in performance output over an extended period of time. Most kinds of training essential regularity repeat and collect trait repetition of the same of original movements. Any invariable training implies hard work. Training should result in a level of personal fitness and is associated with good health. Training is a programme of exercise designed to improve the skills and increase the energy capacities of an athlete for a particular event (Greenberg and Pargman, 1989).

9.3.3 Types of Training

The organisation of strength training deals with actual process of doing strength training in a training session. It, basically, comprises of two things-method of arrangement of strength exercises and loading procedure during a strength exercise. The method of arrangement of strength exercises has three variations which are:

9.3.3.1 Station Training

This is the most common variation and is effective for the improvement of strength abilities especially maximum strength and explosive strength. In station training the required number of repetitions and sets of an exercise are completed before starting the next exercise (Dietrich, 1982).

9.3.3.2 Set Training

This variation is suitable for developing strength endurance. But it is also effective for improving maximum and explosive strength with element of endurance. Two to three exercises are done in the form of a set. One set of each exercise is done in rotation before starting the next set. In set training, the exercises for different muscle groups should be selected. This enables one to have shorter recovery periods thus reducing the total duration of exercise.

9.3.3.3 Circuit Training

Circuit training is a very popular and effective variation for the improvement of strength endurance. In circuit training several exercises are done one after the other. Completing of one set of each exercise in rotation is called one round. There are normally three or more rounds in circuit training. In circuit training there are generally 5-12 exercises. It can be done according to any of the three basic methods of conditioning. But, generally it is done, according to continuous or interval method.

Circuit training is probably the most common training regime used by a wide range of sports and activities in order to improve performance. A circuit

consists of a number of different stations at which the athlete performs a given exercise as many times as is possible within a given time period, when the time is completed the individual moves on to next station and performs a different exercise for a similar period of time around the various stations. To integrate endurance and muscular programme, circuit training incorporated a number of resistance exercises, in a continuous series, forcing to move in a set pattern with specific distances in between. The number of type of exercise, resistance and repetitions vary according to individual level and expectations (Conolly and Einzeing, 1986).

Each exercise is done at a moderate rate to quick pace before moving to the next. At specific points there are periods set aside for lighter continued endurance depending on exercise. A circuit should be completed 2 or 3 times (Budd, 1982). Circuit training is a method of physical conditioning that employs both apparatus resistance training and callisthenic conditioning exercises. It provides a mean of achieving optimal fitness in a systematized controlled fashion. The intensity and vigour of circuit training are indeed challenging and enjoyable to the performer. This system produces positive changes in motor performance, general fitness and muscular power, endurance and speed. Circuit training is usually used to develop general all round physical fitness rather than specialized performance in a specific activity (Arnheim, 1987).

Importance of Circuit Training Circuit training is used to develop general all round strength and local muscular endurance. A basic circuit should include exercises aimed at developing the arms, shoulders, trunk and legs. Fitness is developed by gradually building up the numbers of sets and repetitions to be completed in each session.

As the subject develops, he can make the circuit more demanding by adding resistance or by altering each exercise to make it more difficult. Circuits can also be designed which will make use of the fixed weight machines. A large number of persons can be accommodated at the same time. The individual works at her own rate within her capacity. The goals are both immediately obtainable and easily evaluated (Arnheim, 1987).

Circuit training method has been accepted by physical educators, coaches and trainers as an excellent and self motivating means of increasing strength, flexibility and endurance in an orderly fashion within the groups. Circuit training aims at developing general or basic fitness which is a pre-requisite to every sport. Circuit training can be used for general fitness purposes or can be adopted as a conditioning medium for various sports.

9.3.4 Training and Fitness

Once the development of physical fitness is aimed, exercises conditioning and training strikes the mind. Exercises build confidence, physical and mental ability, cultivate power of will and determination and promote personal efficiency and all mental characteristics. Exercises with or without weight and which are arranged in a circuit may help to develop the physical fitness level.

Training means a systematic scientific programme of conditioning exercises and physical activities designed to improve the physical fitness and skills of the players or athletes participated. Training means preparing for something an event a season of athletic competition a nursing career or operative performance of militancy combat. Much growth and change occur during training.

Check Your Progress 5

7) What are the benefits of training and what are the types of training programs?

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9.4 YOGA

Yoga is an ancient health but developed and perfected over the centuries by the sages of ancient India. Yoga is universal, benefitting all people of all ages. Yoga is a devised way and means of helping the body and mind to maintain this state of balance. According to Githananda, yoga is a positive way of maintaining physical upkeep, mental alertness and spiritual attainment. It teaches us how to control one's senses, resulting in an integrated personality, freedom, stress, conflict and the like. It stabilizes one's behavioural pattern developed will power and ultimately helps one to lead a healthy happy and balanced life.

All the asanas which have an effect on the diaphragm help to massage the heart and at the same time massage the abdominal organs. Yoga helps to keep the body in proper shape and to increase the power of resistance (Githananda and Bhavani, 1989).

9.4.1 Importance of Yoga

Positive changes in the life style of the people can be brought through yoga. During the period of education of yoga can make them aware of their bodies and further make them realise the need of emotional and physical well being. Their behaviour can also be moulded properly, leading to balanced, personalities. Yoga plays an important role by bringing the therapeutic effects in asthma, diabetes, hyper tension, respiratory troubles and the like some yoga has both preventive as well as curative values. Yoga, was thus the most devoted and dedicated approach to personality and it is perhaps the promising pursuit of man and his nature. Yoga therefore, should have an integral place in the pattern of our education with proper physical, emotional, and mental capacity so that one may develop into a well adjusted person for his own benefit of the society around him.

9.4.2 Yoga and Fitness

Yoga asanas not only develop muscles and the body but mainly regulate the proper activities of all the internal organs and glands to affect the nervous system and that which control our well being to a much greater degree than we actually suppose. They help to keep the body in proper shape and to increase the power of resistance (Chinnasamy, 1992).

Check Your Progress 6

8) What is the importance of yoga in fitness?

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9.5 SUMMARY

Physical fitness refers to the overall individual physical condition. Physical fitness is of great importance for all human beings irrespective of age. A person may not be able to perform a particular task if he lacks required physical strength. It is different for each person and can range from extreme illness and near death, to peak performance, like top Olympic and decorated athletes A player in good physical condition is generally thought to have the ability to do sustained work. For a good performance in any sport or athletic event, achievement of a high standard of fitness is a basic requirement.

Physical fitness includes speed, flexibility, power, strength, co-ordination, muscular endurance, cardiovascular endurance and agility. These characteristics are all equalized with the healthy functioning of the body. Another, but a different and important component of physical fitness is the athletic skill. The first step to improving fitness or sports performance through physical conditioning is to design a program with the goals and needs of the sport in mind. Training means a systematic scientific programme of conditioning exercises and physical activities designed to improve the physical fitness and skills of the players or athletes participated. Training means preparing for something an event a season of athletic competition a nursing career or operative performance of militancy combat. Much growth and change occur during training.

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9.7 ANSWERS TO CHECK YOUR PROGRESS

1) Physical fitness refers to the overall individual physical condition. It is different for each person and can range from extreme illness and near death, to peak performance, like top Olympic and decorated athletes.

2) Physical fitness is holistic; it encompasses several areas, including: agility, endurance, power, speed, strength, co-ordination, dexterity and flexibility.

3) Having good flexibility can benefit athletes in several ways such as: better performances, fewer injuries, optimal readiness for training and competition and enhanced recovery from activity.

4) The top 10 benefits of physical activity

   a) Weight management
   b) Bone and muscle health
   c) Relief from physical pains
   d) Protection against health conditions
   e) Younger, healthier skin
   f) Boosts mental health
   g) Energy level boost
   h) Improvements in mood
   i) More quality sleep
   j) Higher libido

5) The body has three very different systems, all working together to provide working muscles with energy:

   Anaerobic a lactic system - requires no oxygen, uses energy stored in the muscle for fuel and produces no lactic acid. It is the main source of energy for activity lasting up to 10 seconds.

   Anaerobic lactic system - requires no oxygen, uses carbohydrates for fuel and produces lactic acid. It is the chief source of energy for activity lasting between 10 seconds and 2 minutes.

   Aerobic system - requires oxygen, uses fats and carbohydrates for fuel and produces no lactic acid. It's the main source of energy for activity lasting more than 2 minutes.

6) The first step to improving fitness or sports performance through physical conditioning is to design a program with the goals and needs of the sport in mind. Not every sport or form of exercise requires each component of physical conditioning in equal proportion, if at all. The training programs of a sprinter differ significantly from those of a long-distance runner, for example. Creating a training program with the help of strength and conditioning specialist can optimize performance and minimize the chance of injury. Specialists evaluate athletes and their current level of fitness, strength, and endurance and design the program based on the athlete's specific needs. Conditioning programs also involve cross-training—using various sports or exercises to improve overall performance. Cross-training creates different physical stresses on the athlete's body than those associated with the athlete's usual routine, improving the athlete's overall performance and also decreasing the risk of suffering an overuse injury. Athletes should also consider adding exercise or resistance programs that differ from their normal routines. For instance, swimmer training for an upcoming meet might benefit from

a long run once a week to decrease stress on her shoulder. Athletes who use conditioning to lose weight need to ensure that they are eating enough calories and obtaining the proper vitamins, minerals, fluids and supplements to meet their training needs. Athletes should consider consulting a sports nutritionist for guidance.

7) Although every training program is unique to sport, the principles relevant to all athletes are: specificity, frequency, overload, duration, progression, rest, monitoring, adaptability, reversibility, overtraining and maintenance.

   Training is done over an extended period of time to achieve training goals. Training may affect the psychological, emotional and physical status. It is usually intended to produce positive or desirable change. Training should result in a level of personal fitness and associated with good health. Training is a programme of exercise designed to improve the skills and increase the energy capacities of an athlete for a particular event.

   The method of arrangement of strength exercises has three variations which are: station training, set training and circuit training.

8) Yoga asanas develop muscles and the body and also regulate the proper activities of all the internal organs and glands to affect the nervous system and that which control our well being to a much greater degree than we actually suppose. All the asanas which have an effect on the diaphragm help to message the heart and at the same time message the abdominal organs. They help to keep the body in proper shape and to increase the power of resistance.

UNIT 10 EFFECT OF DIVERSE CONDITIONS*

Contents

LEARNING OBJECTIVES

After going through this unit you will be able to:

- focus on human compatibility to the environment and its diverse nature;
- understand the physiological coordination of the whole body, environmental adaptability and techno-adaptability;
- understand alterations of cardio-renal functions with respect to physical performance, malnutrition; and
- learn about life style diseases due to diverse conditions like smoking behaviour, alcohol use, drug abuse, pollution and occupational conditions.

10.0 INTRODUCTION

Physiological anthropology focuses on the capacity for environmental adaptation seen in the physiological functions of present-day humans. Areas of study include physical and cultural aspects related to living environments as factors that affect the capacity for environmental adaptation.

*Contibutor: Dr. Sandip Sinha, Assistant Professor, Department of Human Physiology with Community Health, Vidyasagar University, Paschim Medinipur.

The underlying approach to physiological anthropological research through survey work is to investigate from all perspectives the environmental differences between the hunter-gatherer age, to which humankind is biologically adapted and the present environment in which we tend to seek the comforts of a highly technological society. Then, the effects of those differences on human adaptability are examined through different methods. In spite of that, survey work plays an important role for the promotion of physiological as well as anthropological research in respect to biological, social and cultural heritage of the place around the globe.

Physiological anthropology involves an evolutionary perspective towards the study of human populations and their diversity. It is a dynamic and interdisciplinary field, drawing on many lines of evidence to understand the human experience, past and present. In this unit, it is attempted to explain the scientific approach, and different fields such as environment, lifestyle factors, psychology, technology and malnutrition in the light of physiological anthropology.

Check Your Progress 1

1) What is the focus of physiological anthropology?

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10.1 FACTORS AFFECTING PHYSICAL PERFORMANCE

In this modern era, variations in human performance depend on an individual's well being and adaptability to environment. Human biology, cultural and physiological anthropology, laboratory research and bio-cultural methods, all together solve the problems of human adaptability in this world. Physical performance is mainly a function of an individual's size, shape, sex, and age, though not entirely so. Success in physical performance at whatever level also depends on fitness. Let us have a look at the essential regulatory factors.

10.1.1 Impact of Smoking on Physical Performance

Anthropologists have long studied tobacco, what is today the world's greatest cause of preventable death. Tobacco addiction remains a substantial problem in India and worldwide. Smokers are compelled to smoke by addiction to nicotine but the harm is largely done by the 4,000 plus other chemicals in the tar and gases produced by burning tobacco. It is this combination that makes tobacco so deadly. Although not all smokers become nicotine dependent, the

prevalence of individuals diagnosed as nicotine dependent is higher than that for any other substance abuse disorder (Anthony et al., 1994; CDC, 1995b; Kandel et al., 1997). Nicotine (from any tobacco substance) has structural similarity to a body neurotransmitter acetylcholine (ACh) which conveys information from one neuron to another. Acetylcholine is an important neurotransmitter involved in systems concerned with mental and physical arousal, learning and memory, and several aspects of emotion.

Tobacco is considered as a major behavioural risk factor for non-communicable diseases (like ischemic heart diseases, cancers, diabetes, chronic respiratory diseases) one of the leading causes of death globally and associated with tobacco use. According to WHO statistics for 2010 in India, NCDs are estimated to account for 53% of all deaths. Of these deaths, cardiovascular diseases and diabetes are the most common cause of deaths in India.

Smoking acts synergistically with other risk factors like high cholesterol and blood pressure to increase the risk of Coronary Heart Diseases (CHD), respiratory disease like Chronic Obstructive Pulmonary Disease (COPD). It includes chronic bronchitis and emphysema, asthma: smoking is associated with acute attacks of asthma and tuberculosis. Smoking also affects pregnant mothers and newborns resulting in impact on childhood.

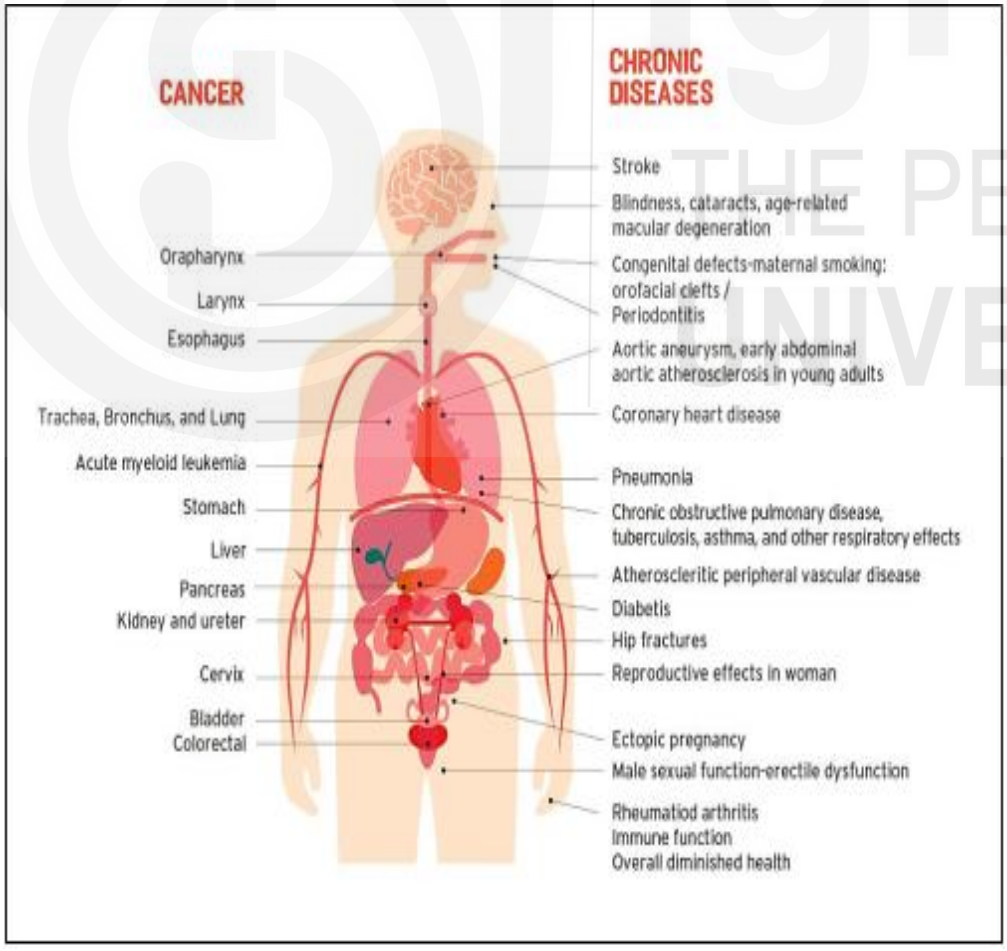

Figure 1: Different diseases due to direct and indirect smoking

***Source*:** U.S. Department of Health and Human Services, Center for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, 2014

Check Your Progress 2

2) Write about the impact of smoking on physical performance.

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10.1.2 Physical Performance and Alcohol

Alcohol, like many other global commodities, is an agent and symbol of the overall forces of globalisation that affect common people; at the same time alcohol and drinking are actions and symbols that are part of forces that seek to inhibit external interference in local and national matters. The recognition and acceptance worldwide should stimulate more anthropological and sociological research into the production and consumption of drinking than has been done in the past.

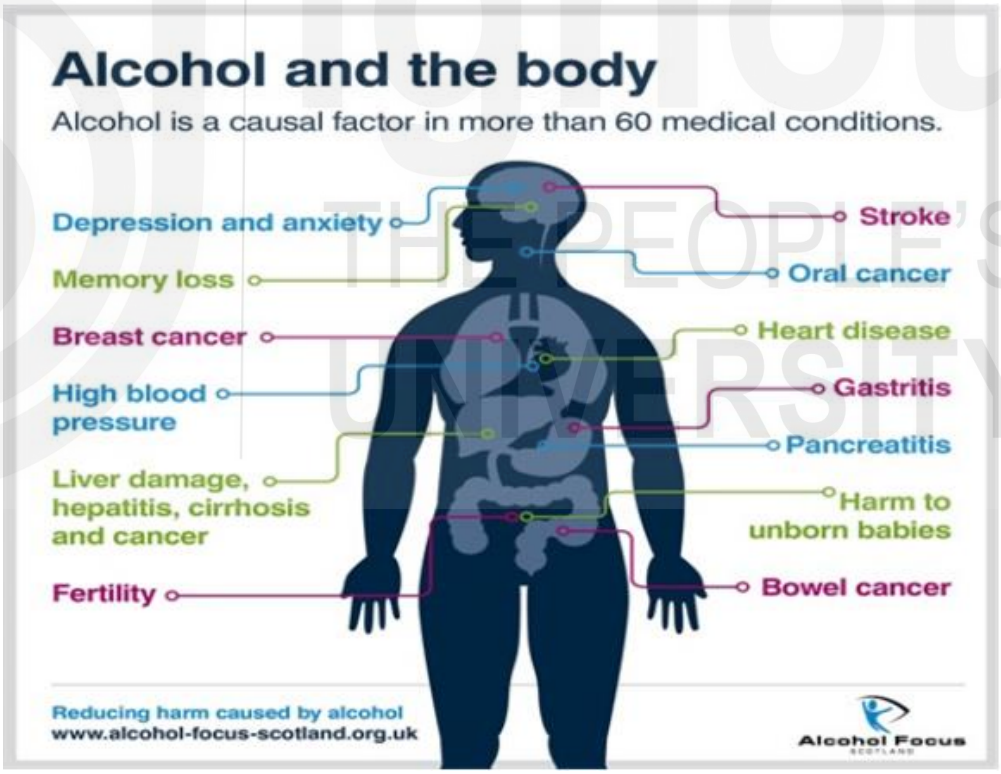

Figure 2: Physiological effects of alcohol drinking

***Source*:** www.alcohol-focus-scotland.org.uk

Basically alcohol is a diuretic, drinking too much can lead to dehydration because alcohol makes your kidneys produce more urine. Exercising soon after drinking alcohol can make this dehydration worse because you sweat as your body temperature rises. Combined, sweating and the diuretic effect of exercise make dehydration much more likely. We all know that dehydration leads to reduced performance and that hydration also helps control our body temperature so we are more likely to overheat if we have been drinking

alcohol. On the other hand, alcohol interferes with the way our body makes energy. When you're metabolising, or breaking down alcohol, the liver can't produce as much glucose, which means you have low levels of blood sugar. As a result, our coordination, dexterity, concentration and reactions could be adversely affected too.

Check Your Progress 3

3) "Alcohol interferes with the physical performance of sports persons". Justify the statement.

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4) How alcohol is responsible for the disruption of physiological functions?

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10.1.3 Physical Performance and Drug

When a person uses drugs, many changes occur in his/her body, both physically and psychologically. Some of these changes occur immediately, while others only happen over time. Every side effect of drug use has the potential to be severe, but the physical effects can be especially dangerous. One should therefore try to avoid combining drug use with any type of physical activity. The National Institute on Drug Abuse lists several common physical side effects of drug use like change in appetite, confusion, dilated pupils, distortions in perception, dizziness, dry mouth, flushing of skin, impaired coordination and balance, increased energy and alertness, increased heart rate, blood pressure and body temperature and nausea.

Drug use and physical performance are most often associated with a variety of substances designed to improve athletic performance (e.g. anabolic steroids, human growth hormone)**.** Many of these substances are illegal without a prescription and/or banned by sporting agencies. Rates of performance enhancing drug use may be higher among elite athletes, where the stakes and incentives for optimal performance are quite high. These estimates are consistent with several anecdotal reports in the popular press estimating that performance-enhancing drug (PED) use rates are relatively high among elite adult athletes, particular in certain sports e.g., football or track and field.

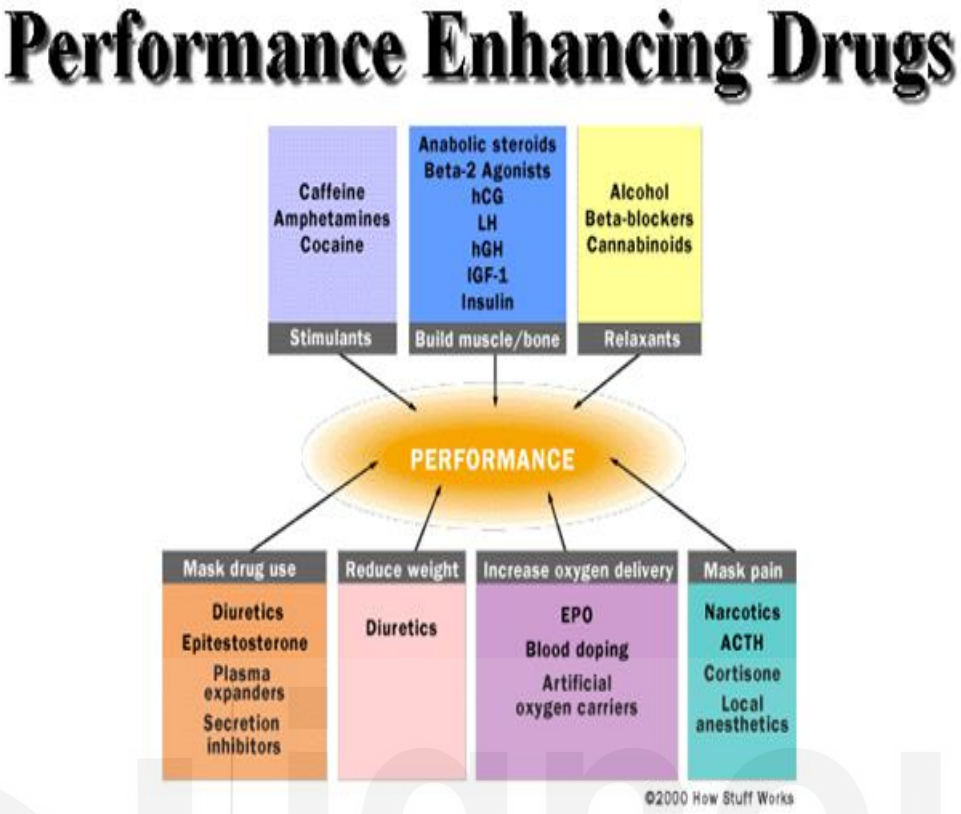

Figure 3: Performance enhancing drugs

***Source*:** Freudenrich & Allen (2000), www. entertainment.howstuffworks.com/athletic-drug-test.htm

Check Your Progress 4

5) Write a short note on drug abuse and physical performance.

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6) Describe briefly the negative effects of performance enhancing drugs in athletic sports.

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10.1.4 Physical Performance and Pollution

It is well established that contaminated air is killing 7 million people annually, and harming billions more. In this situation the rate of respiratory and the cardiovascular diseases with respect to short-term and long-term are developed due to inhalation of air pollution**.** Physical performances are closely associated with these cardio-respiratory disturbances. Exposure to freshly generated mixed combustion emissions such as those observed in proximity to roadways with high volumes of traffic and those from ice resurfacing equipment are of particular concern. This is because there is a greater toxicity from freshly generated whole exhaust than from its component parts. The particles released from emissions are considered to cause oxidative damage and inflammation in the airways and the vascular system, and may be related to decreased exercise performance (Figure 4).

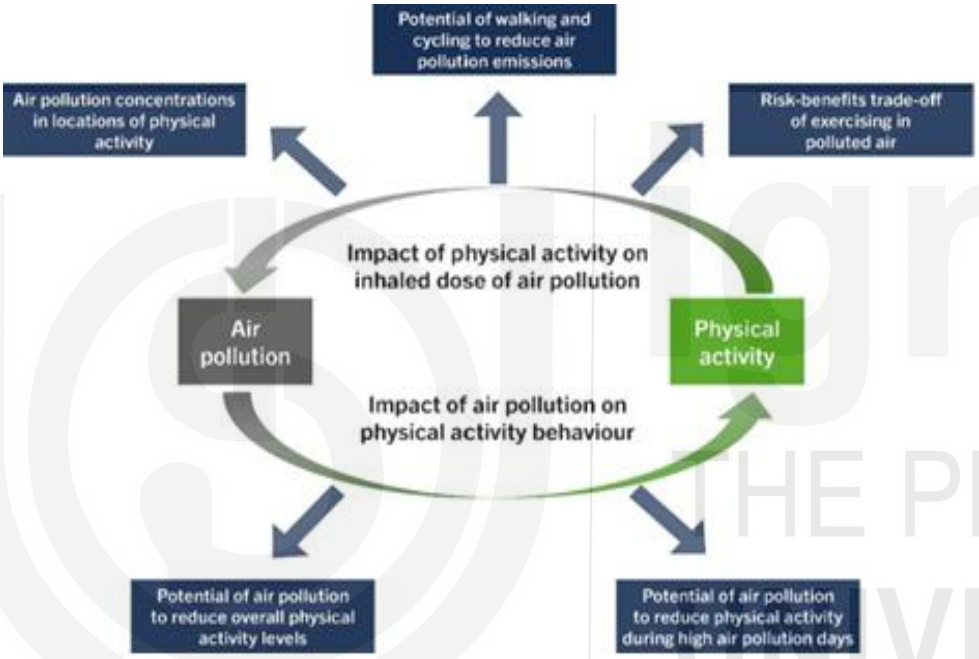

Figure 4: Schematic overview of the air pollution and physical activity interactions

***Source*:** Tainio et al., 2021, www.entertainment.howstuffworks.com/athletic-drug-test.htm

The effects of air pollutant (e.g. sulfur dioxide) during exercise are much higher than during rest because of a higher ventilatory rate and both nasal and oral breathing in the former case. However, with oral pharyngeal breathing, the amount of sulfur dioxide that is absorbed is significantly less, and with exercise and oral pharyngeal breathing a significant decrease in upper airway absorption occurs, resulting in a significantly larger dosage of this pollutant being delivered to the tracheobronchial tree**.**

Check Your Progress 5

7) Describe how air pollution of an environment causes lowering of physical performance?

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10.1.5 Occupation and Physical Performance

Occupation is a major contributor to physical injuries and disease as well as economic loss amounting to 4%-5% of GDP. The World Health Organisation (WHO) and the International Labour Organisation (ILO) estimate that there are around 2.2 million work-related deaths per year. Globally only 10%-15% of workers have access to a basic standard of occupational health services (http://www.cdc.gov/niosh/programs/global/risks.html). Different findings show that physical requirements of tasks are reflected in job analyses. Principal components analyses of both, job analysis and test performance data suggest that the structure of physical abilities has 3 major components: strength, endurance, and movement quality. This structure appears to be independent of job type or level of incumbents' performance (Figure 5).

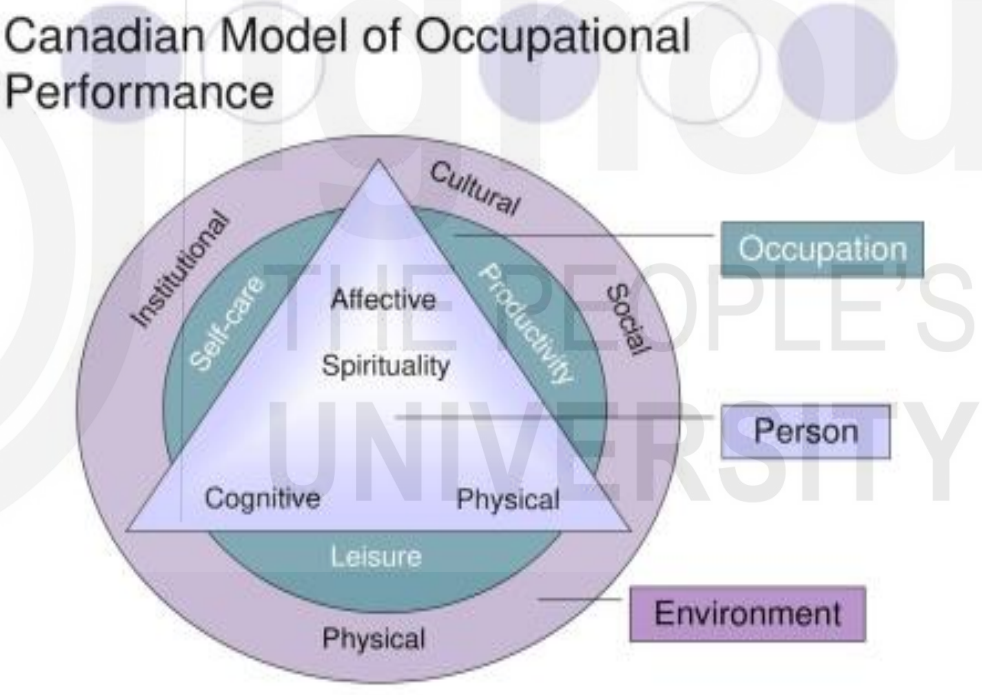

Figure 5: Relation between occupation and physical performance

***Source*:** Townsend & Polatajko, 1997. Enabling occupation II: Advancing an occupational therapy vision for health, well-being and justice through occupation.

Using risk measures applied to the proportions of the population exposed to selected occupational hazards, the WHO has estimated attributable fractions, deaths, and disability-adjusted life years (DALYs) for selected occupational risk factors. Worldwide, these selected risk factors were estimated to be responsible for back pain (37%), hearing loss (16%), chronic obstructive pulmonary disease (COPD) (13%), asthma (11%), injuries (8%), lung cancer (9%), leukaemia (2%) (WHO, 2019).

Check Your Progress 6

8) Explain the correlation between occupation and physical performance.

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10.2 PHYSICAL PERFORMANCE AND ENVIRONMENTAL STRESS

Stress generally is a situation or condition which places an individual under some pressure, involves adjustment in behaviour and can cause changes which are unpleasant, sometimes maladaptive and even associated with physical damage. Environmental stress can be defined as pressure on the environment caused by human activities (such as generation of pollution) or by natural events (such as occurrence of a drought). "The environment" is often seen as leading to damage to mental and physical health by contributing to stress (Figure 6).

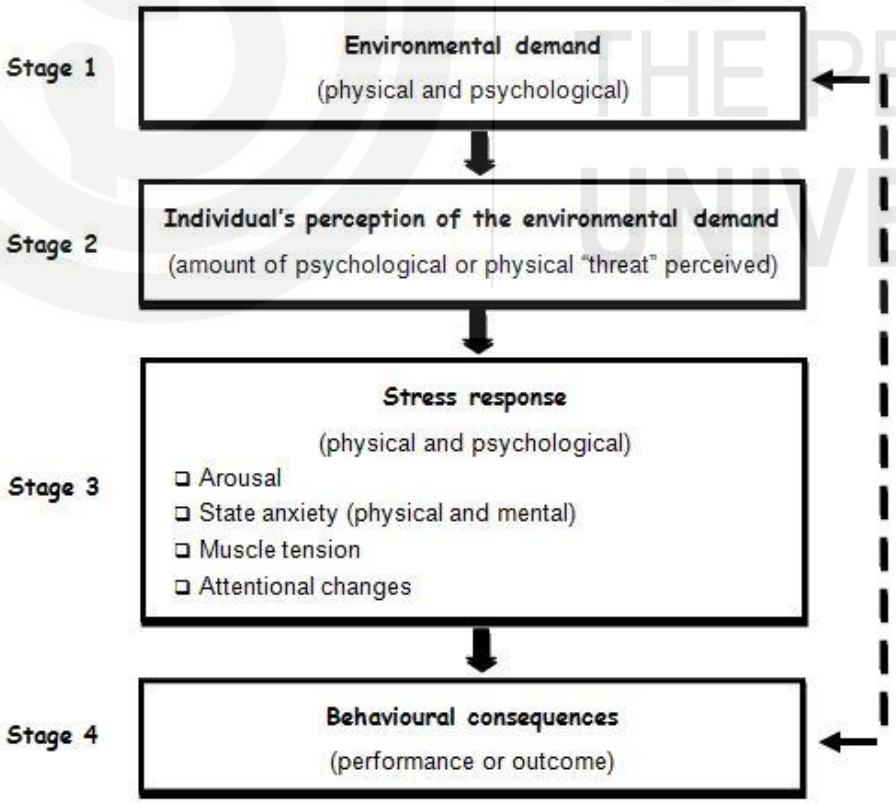

Figure 6: Relation between the environmental stress and behavioral response

***Source*:** Stress Response Process, Reilly & Williams, 2003

The most important environmental stresses today are those that have resulted from housing and other attempts to ameliorate the thermal environment. These include air pollution, physical injuries from building surfaces and the extremes of confinement. Physical performance is primarily a function of subject demographic profile, but not entirely so. Physical fitness is sport specific and in many sports it is also position specific as well as depends on many factors like thermo-regulatory, cardiovascular, and metabolic stress, may contribute for the reduction in physical performance capacity during exercise in the heat due to increases in core temperature, heart rate, rate of perceived exertion (Marino et al., 2001; Peiffer et al., 2011) and metabolic rate (Parkin et al., 1999) as well as dehydration (Gonzalez-Alonso et al., 2008).

Check Your Progress 7

9) Explain the correlation between environmental stress and physical performance.

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10.3 PHYSICAL PERFORMANCE AND TECHNO-ADAPTABILITY

Presently technological environment has developed rapidly, when we consider the time scale of human history, and rapid advances in science and technology are thought to be exerting profound effects on the human community, in terms of not only lifestyle and culture, but also the physiological capabilities of the human body (Yasukouchi, 2014).

Engagement in physically simulated sport games yielded benefits to cognitive and physical skills that are directly involved in functional abilities, older adults need in everyday living (Maillot et al., 2012). Physical activity pro files, goal setting, real time feedback, social support networking, and online expert consultation were found as the most beneficial ways to drive physical activity change. The range of novel and engaging intervention strategies used by smartphones, and user perceptions on their usefulness and viability, highlights the potential such technology has for physical activity promotion (Bort Roig et al., 2014).

10.4 PHYSICAL PERFORMANCE AND MALNUTRITION

Malnutrition has been defined “a state resulting from lack of uptake or intake of nutrition that leads to altered body composition (decreased fat free mass)

and body cell mass leading to diminished physical and mental function and impaired clinical outcome from disease" and, in this definition, is synonymous with under nutrition. Nutritional status deteriorates with aging, leading to several changes in body composition, which may include depletion of body fat stores and muscle wasting and contribute to a loss of muscle strength and symptoms such as fatigue. Numerous studies have demonstrated that nutritional status has an important influence on physical performance and disability in older subjects (Singh et al., 2014; Ferreira et al., 2013; Sergi et al., 2007; Zuliani et al., 2001). Prerequisites to optimum physical perfor mance include muscle strength, muscle and cardiovascular endurance, flex-ibility, fitness, agility, and balance depends on nutrition. Nutritional status also acts as a determination factor for physical performance with aging (Alipanah et al., 2009). Physiologically, under nutrition causes depletion of body fat stores, muscle wasting (Vellas et al., 1992) and symptoms such as fatigue or tiredness (Furman, 2006) leads to poor physical performance.

Check Your Progress 8

10) How is malnutrition status and physical performance associated?

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10.5 PHYSICAL PERFORMANCE AND LIFE STYLE DISEASES

Physical fitness is the general capacity to adapt and respond favorably to physical effort. Wellness is the search for enhanced quality of life, personal growth, and potential through positive lifestyle behaviours and attitudes. It is an active process of becoming aware of and making choices toward a more successful existence. To live long and successful happy life, fitness and wellness is must. Lifestyle change, more than any other factor, is considered to be the best way of preventing illness and early death in our society. TV, computer, video games are spoiling the health of our children. With all the medical facilities available today, physical problems are increasing. Besides obesity, cardiovascular diseases, cancers, high blood pressure, joint pains and spondylitis etc. are increasing because of modern lifestyle (Baroa et al., 2016).

Malnutrition, an unhealthy diet, smoking, alcohol consumption, drug addiction, stress, and so on are examples of unhealthy lifestyles that are widely practiced. Hundreds of millions of individuals are caught into it. As a result, individuals face illness, incapacity, and even death. An unhealthy lifestyle can lead to issues such as metabolic disorders, joint and bone problems, cardio-vascular diseases, hypertension, obesity, violence, and so

on. Metabolic syndrome is associated with lower physical capacity, and physical fitness and healthy lifestyle behaviours play a determinant role in coronary heart disease risk factors. For instance, Rheumatoid arthritis is associated with an increased risk of developing comorbidities, some of which are also known to be associated with lifestyle habits such as physical activity, diet, smoking, and alcohol. There has been an augmented focus on the implementation and maintenance of healthy lifestyle habits even for patients with Rheumatoid arthritis in the past decade. Obesity afflicts older adults and contributes significantly to poor physical and mental health outcomes Suboptimal quality of life (QOL) and mental health conditions, including depression, often co-occur with obesity and this co-occurrence may be especially likely in the presence of impaired physical function. The obesity-mental health association appears to be stronger in late life than early or middle adulthood. Diabetic patients experience various types of psychosocial and emotional problems due to which the monitoring of own state of health is not the priority in life. In the process of treatment of both sole diabetes and concomitant anxiety and depression it is important to adjust and motivate patients to apply widely understood therapeutic recommendations. The link between lifestyle and health should be carefully considered. Resilience and active coping styles are beneficial to prevent chronic illnesses and increases self-perceived quality of life (Tabish, 2017).

Figure 7: Relation between life style and chronic diseases management

***Source*:** School of Medical Sciences: Lifestyle Clinic (2012)

Check Your Progress 9

11) How do physical activities protect you from lifestyle diseases?

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10.6 SUMMARY

Physical performance depends upon several factors which can directly or indirectly influences on it. Age, sex, gender, malnutrition, body weight and height have some crucial role for predicting the physical fitness, at the same time environmental issues (mainly all types of pollution), occupational hazards cause changes in physical performances. On the other hand lifestyle factors like lack of physical exercise, taking too much fast food, daily food habit, smoking, drinking alcohol, techno-adaptability and several drug abuses have a huge impact on physical performance. Therefore, in near future if we do not maintain all these things properly then maximum loss will be in terms of population health, facing high risk of existence throughout the globe.

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10.8 HINTS/ANSWERS TO CHECK YOUR PROGRESS

1) Physiological anthropology focuses on the capacity for environmental adaptation seen in the physiological function of present-day humans.

2) In smokers, less oxygen is delivered to the body's cells and to the heart and lungs. This decrease in oxygen reduces a smoker's physical endurance, causing the heart to work harder and increases heart rate.

3) Alcohol can have many effects on exercise physiological performance, so it is important to distinguish between chronic use, moderate use, and abuse. In case of sports persons it can also impede muscle growth. Long-term alcohol use diminishes protein synthesis, resulting in a decrease in muscle growth. Even short-term alcohol use can affect muscles.

4) Alcohol interferes with the body's metabolism; its consumption causes an increase in insulin secretion, which leads to low blood sugar (otherwise known as hypoglycemia). Alcohol is a mind-altering drug that reduces thinking ability, distorts judgment, and acts as a depressant on the body.

5) When a person uses drugs, many changes occur in his body, both physically and psychologically. There are several types of performance enhancing drugs (PED) are available in the market, various researches reported that little amounts of androgen (e.g. testosterone) above those normally found in the human body have been shown to increase muscle strength and mass.

6) It is presumed that most if not all doping agents have potential short-term and/or long-term side effects. It was already established that use of PED causes increase heart palpitations, heart rhythm abnormalities, weight loss, tremors, mild high blood pressure (hypertension), hallucinations, stroke, heart attack and other circulatory problems. It also causes lots of side effects such as insulin resistance, hyperglycemia, diabetes mellitus, cardiomegaly, hastened, Hypertension, tachycardia, myocardial infarction, stroke, heat stroke, weight loss, headache, nausea, tremor, insomnia, anxiety/panic attacks, agitation, aggression, psychosis, bradycardia, increased airway resistance etc.

7) Air pollution levels are found to be negatively associated with physical activity. The health effects of air pollution are serious- one third of deaths from stroke, lung cancer and heart disease are due to air pollution along with some other diseases such as asthma, lung cancer, ventricular hypertrophy, Alzheimer's and Parkinson's diseases, psychological complications, autism, retinopathy, fetal growth, and low birth weight.

8) Work-related problems can affect our physical, emotional and mental health. Common issues include job dissatisfaction, workplace injury, stress, discrimination and bullying, violence, accidental death and retirement. Occupation factors may give rise to a very wide range of injuries and diseases. Job loss, retrenchment or unexpected loss of income can also cause distress and hardship. Increased working hours can cause reduced sleep hours. The effects of sleep deprivation include fatigue, increased stress and weight gain. Increase stress levels are also associated with long working hours. Stress can cause heart conditions, mental health disorders, high blood pressure and more.

9) There are a number of factors within a particular environment that can contribute to the performance outcome of an athlete's effort. Environmental stress factors include temperature, food, pollutants, population density, sound, light, and parasites. In between these factors like extreme heat or cold, high altitude and air pollution can elevate heart rates, make it harder to breathe, and impair the ability to exercise. In either case, the athlete is at risk for hyperthermia and significant physiological performance stress.

10) Malnutrition and poor physical performance are two highly prevalent conditions in all peoples specially athlete that are associated with poor health outcomes, such as higher morbidity, mortality, and lower quality of life. Muscle is a key linking substrate between malnutrition and physical performance. Decreased muscle mass has been found to be an outcome of malnutrition and decreased muscle power has been found to be a predictor of physical performance. At the same time athletes can increase their stores of glycogen by regularly eating high-carbohydrate foods.

11) Regular physical activity can improve muscle strength and boost endurance. Exercise delivers oxygen and nutrients to tissues and helps cardiovascular system work more efficiently. Regular physical activity can help prevent heart disease, stroke by strengthening the heart muscle, improving blood flow, lowering blood pressure, raising HDL levels, lowering LDL cholesterol levels, can help insulin more effectively lower blood sugar level hence control diabetes.

UNIT 11 PHYSIQUE, NUTRITION AND PERFORMANCE*

Contents

LEARNING OBJECTIVES

After going through this unit, you will:

- know the concept of body physique and body composition;
- realise about the role of human physique and body composition in sports/ activity performance;
- know various aspects of nutrition including its importance during exercise; and
- have reasonable knowledge about the relationship between diet and performance.

11.0 INTRODUCTION

In present day sports, performance demands are continually increasing. It is crucial to note here that sports performance of athletes is highly regulated by their age, stature, weight and body structure. Body composition and body physique play crucial role in sports and activities by directly influencing the biomechanics of movement and performance. It is obvious to have differences in body size, body proportion, height and weight among different people.

Individuals of same age group vary in body size and shape; those of same height differ in their body weight; while others with similar weight differ on their relative proportion of muscle, fat and bone mass. However, the demand for body size, structure and composition vary markedly for sports and activities. Body size and composition could enhance or limit performance in sport events or any other form of activity.

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It could be elucidated that an individual's morphological profile provides a baseline to plan and monitor their performance.

Somatotyping is essentially important here for examining developmental dynamics of specific shape and size of human body, in accordance with the function of skill and training, for both competitive and leisure time-phases. It also helps to decide whether a performer would be suitable to participate in the particular type of sport/ activity with their body profile. It is then that the person with particular body type best suited for an activity/sport could be motivated to follow/take part in that pursuit. It is significant to note here that functional/technical/training, physiological/tactical, biochemical and motor capabilities along with environmental factors and genetic endorsements are equally instrumental as much as somatic characteristics. All these aspects behave differently among different performers giving up variety in body composition and structure that becomes ideal for addressing varying demand for specific body physique, size and proportion in diverse sports and activity arenas.

Kinanthropometry, not a widely circulated term, deals with current status or phenotype of body of an individual. It focuses on measurement of personnel for morphological perspectives like components of body build and maturation; body measurements, proportions, composition, shape; motor abilities; cardio-respiratory capacities; and their application during movement for physical activity, recreational or of specialized sports kind. It acts as a dynamic interface between assessment of structure/ anatomy and function/ movement in/of human. It is used as a performance prediction tool rather than just of a diagnostic nature for selection process but also giving hold for tracking and recognizing the highest success rate. Study of body physique and morphology is indispensable so as to decide upon the ideal standards for championing the respective events at activities and sports. So, kinanthropometry aids at estimating body size differences, somatotyping and body composition.

Body physique that refers to the shape and size of the body of being has a critical role to play in attaining better performance. Human physique differs according to the requirement for a specific sport or activity or an unsuitable body may rather become a barrier in enhancing performance. As for example, specific athletic demands for a different body type, body composition along with an exact range of height and weight for maximum performance. Human physique is under constant influence of fat mass and fat-free mass ratio, apart from environmental and genetic factors. Classification of body physique termed as somatotyping put forth by various scholars and researchers like Hippocrates, Kretschmer, Viola, Sheldon, Parnell to the much recent and widely accepted one proposed by Heath and Carter have helped comprehending the concept and its role much better in day-to-day activities. Somatotyping makes use of adiposity, musculo-skeletal robustness and linearity outlook of a physique rather than for just considering simple linear anthropometric measurements. It is one of the best biological identification tags of an individual. Somatotype of an individual is presented as a combined rating of each of these components, where one of the components being dominant is described to be as the somatotype of the person in terms of that particular component.

Check Your Progress 1

1) Elaborate the benefits of somatotyping.

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11.1 BODY PHYSIQUE

Body physique refers to the shape and size of body. Human physique differs in many ways, whereby various human physiques play important role in attaining better performance in particular sports. Every sport demands a specific type of body physique whereas an unsuitable body type in sports may become a great barrier in the progress of sports performance. Realising the importance of different physiques, during ancient times great Greek Philosopher, Hippocrates during 5th century B.C. for the first time introduced the method of body classification under which the individuals were divided into two body types as '*habitus phthisicus*', one who has a thin and lean body with long extremities, and the other '*habitus apoplecticus*', having short, thick and massive body.

Much later, at the beginning of 12th century, one of the earliest researchers in this field, a German psychiatrist named Kretschmer classified human physique into three categories as *asthenic* or thin type; *athletic* or muscular type; and the final as *pyknic* or fatty type. Further, Viola, an Italian researcher, also in the12th century developed a method to categorise humans into four types as *Longitype*, with long limbs; *Brachitype*, with broad limbs, *Normotype*, having limbs within normal range and the *Mixe* type, with mixed characteristics. Sheldon and his associates, in 1940, devised a method to analyze and quantify human body type to which they referred it to as somatotyping, for which they used photoscopic way to identify different physiques. This technique used a 7-scale method for categorising the body physique as *Endomorphs*, those more with fatty content in them; *Mesomorphs*, more with muscle content in them; and *Ectomorphs*, as those who lack both muscle and fat content in them.

Later in 1967, Heath and Carter modified this method of Sheldon's into a more objective method of somatotyping employing anthropometric measurements. According to them "a somatotype is a description of the present morphological conformation. It is expressed in a numeral rating consisting of three sequential numerals always recorded in the same manner. Each numeral represents the evaluation of the three primary components of physique which describe individual variations in human morphology and composition". As a means for assessing body shape and composition, independent of size, somatotyping is applied to the description of groups of outstanding athletes. Somatotyping began to be practiced among the Olympic

athletes in 1951 by Cureton. Somatotype studies were done by Tanner (1964) at the Rome Olympics, Garay et al. (1974) carried out the largest study on the athletes at the Mexico Olympics and Carter et al. studied athletes at the 1976 Montreal Olympics.

11.2 BODY COMPOSITION

Constitutional make-up of body i.e. body composition is another important ingredient for enhancing sport/activity accomplishments. Physical performance components/physical fitness abilities like speed, strength, agility and coordination are also interwoven in the development of body structure. Skill, psychological features, powerful and capacious energy production systems are important factors in sports performance but body size, shape, proportion, composition and morphology are the major success related factors in sports. Distribution of body weight as a function of different components could be determined in terms of the major constituents of body as fat mass, muscle mass and bone mass. Body composition of athletes is an important tool for evaluating their health, for monitoring the effects of training program and to decide upon the optimal competitive body weight and other components of body composition. Understanding the effects of training on body composition can help athletes in controlling weight and adjust their body composition safely. Seasonal variations in body composition can also be studied and used to find the optimal body composition levels for health, recovery, training and competition. Following body composition trends in specific sports enable coaches to accurately prepare the athletes for specific events or positions. Due to the great significance of body composition in athletic health and performance, it is crucial to ensure a safe, practical and efficient method of computing body composition.

Body fat percentage is specifically of greater interest to athletes while talking about body composition, since it is often negatively associated with athletic performance. Athletes for a specific sport represent a unique body composition. Density of fat free mass alters with changes in proportions of fat free mass components. Greater lean body mass, strength, power, lower body fat percentage and earlier maturation are associated with young, elite male athletes. While on the other hand, young, elite female athletes have lower percentage of body fat, later maturation and a less “curvy” physique. Sportspersons and athletes have a different physiology and health consequences associated with their body composition compared to the general non-sports playing group, making body composition is an important field of study in sports physiology. For achieving excellent performance in sports and athletics, physical characteristics and body composition have been known to be instrumental to refine and work upon. Body composition can act as a predictor of athletic performance, making it relevant for both athletes and coaches. Physical performance tends to decline with increasing body mass and fat percentage, one or the other reaching to extreme levels. However, complementary nature of a higher or lower body fat content is driven by the type of sports activity that has to be performed. That is why, the body composition trends specific to different sports could provide a way out for

identifying and categorizing the potential participants for a particular event/activity.

Body composition becomes a safety issue in weight-dependant sports, like wrestling. Body fat percentage is an important factor in endurance events because extra fat increases the demand of energy needed for running without giving any extra energy in return. There exists a significant relationship between body fat percentage and running performance. Lean body mass, on the other hand, acts as a better predictor of performance than fat mass in strength events. Excess of body fat has harmful effects on the performance in most of the sports whereas, fat free body mass, specifically muscle mass, and is generally related with highly refined performance.

11.3 NUTRITION

It is the intake of food, in relation to the dietary demands of an organism which is dealt under the scope of nutrition and nutrition-based studies and researches. Good nutrition in an adequate amount or what is popularly known as the 'balanced diet' when combined with regular, adequate physical activity forms one of the cornerstones of sound health. Basic understanding of nutrition and its effects upon health, weight control and physical performance is a matter of immense significance. Poor nutritional condition majorly reduces immunity, increase susceptibility to diseases, lead to impaired physical and mental development, and reduce productivity.

Following Nutrients form Constituents of Every Diet:

Carbohydrates furnish energy to the millions cells within the human body. They are classified as monosaccharides, disaccharides, or polysaccharides. The most common monosaccharide carbohydrate is glucose which is oxidized and used directly by the body for energy, broken down by the digestive system, converted into glycogen (a polysaccharide) and stored in the muscle and liver for later use. However, if the storage capacity for glycogen is exceeded in muscles and liver, the excess glucose is converted into fat and stored in the fatty adipose tissue of the body. Therefore, if a person is on a high carbohydrate and low fat diet, it is still possible for that person to increase his/her fat level.

Fats have several major functions in the body, such as- (i) energy storage which can be used as fuel as the body needs it, (ii) carrier for soluble vitamins A, D, E and K throughout the body, (iii) providing soft cushion against inside and outside shocks or blows to vital organs such as the heart, lungs, kidneys, liver, spinal cord, etc., (iv) heat insulator to protect body against cold weather and (v) retarding or depressing hunger pangs. Fat molecule consists of carbon, oxygen and hydrogen. Fats contain lesser oxygen and more carbon and hydrogen than carbohydrates, thus acting as greater fuel provider but has a greater oxidation cost. Chemically, a fat molecule is made up of fatty acids and glycerol. Fats are stored in the body in the form of triglycerides.

Proteins contain nitrogen in addition to carbon, oxygen and hydrogen. Proteins are 'building blocks' of tissue, so every cell in the body needs protein. They furnish the basic material for muscular contraction. Proteins are made up of nitrogenous compounds called amino acids which are of 20 different types, of which 8 are essential and are not synthesized within body. The essential amino acids are obtained directly from diet are: isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan and valine.

Vitamins are organic substances that are essential for human life. Living cell cannot manufacture vitamins, so they are to be provided either in diet or through supplements. They are generally classified as water soluble and fat soluble. Fat soluble vitamins are composed of carbon, hydrogen and oxygen, whereas water soluble vitamins contain nitrogen, cobalt and sulphur in addition to carbon, hydrogen and oxygen. Fat soluble vitamins can be stored in body whereas water soluble vitamins could not be stored in body.

Minerals, like vitamins, provide no energy however each mineral has a diverse function which is vital for proper functioning of the body. Minerals are essential for the formation and maintenance of bones, teeth, muscles, cells and certain connective tissues, body fluids, hormones and enzymes. They make up approximately 4% of the body weight. Mineral deficiency can lower an athlete's efficacy. Depleted minerals during exercise can be replaced by diet or through supplementation.

Water makes up 40%-60% of the total body weight but it is not classified as an energy nutrient. Water not only provides the medium for all chemical processes to take place in but it also assists in forming blood plasma, digestion of foods, glandular secretion and in waste elimination.

Recommendations on current energy, nourishment-demands and optimum liquid-intake for active adults and competitive athletes:

For high-intensity training, adequate energy needs are critical to keep a check over body weight, maximize effects of training and maintain a healthy state. Otherwise, the lower energy intakes would result into degeneration of muscle mass, menstrual dysfunctioning, loss of bone mineral density, and failure to regain the bone density. It may also lead to increased frequencies of fatigue, injury and illness relating events. Body weight and its composition have an upper-hand in exercise performance, significantly influencing it. But those being the sole criteria for deciding participation in sports this consideration could later prove to a fallacy. Therefore, daily weighing is and should be discouraged. Age, sex and hereditary factors play key role at deciding, along with the type of sports they are to play, the varying levels of optimal body-fat among players. However, desired management of weight and fat should start early before the competitive season, under close supervision of a trained health and nutrition-professional.

Carbohydrates chiefly regulate the glucose levels in bloodstream and muscle glycogen replacement mechanism. During exercise, the recommended quantities of carbohydrates for athletes range from 6 to 10 grams for per kilogram of the body weight, per day. Required nutritional count is decided upon by an athlete's total energy expenditure that they are about to make

during the activity event, type of sports activity to be performed, gender-based differences and environmental conditions. Protein requirements are recorded to be considerably more in highly active people. Protein recommendations for endurance athletes tend to be 1.2 to 1.4 g/kg of the body weight on a per day basis. While for resistance and strength trained/ training athletes, it should be as high as 1.6 to 1.7 g/kg of the body weight, per day. Even without the use of protein or amino acid supplements, such recommended protein intake amounts could generally be met through diet alone, provided that the energy intake is adequate to maintain body weight.

Now, it is important to note here that no significant benefit is added to the performance upon consuming diet that contains less than 15% of energy compared with 20% to 25% of energy sourced from fats, for which its intake should not be restricted. Fats form an important portion in the diets of athletes. Reason being, it not just provides energy but also supplies with fat-soluble vitamins (vitamin A, D, E, K) and some very essential fatty-acids. Additionally, there is lack of research and data on which scientific basis using recommended levels of fat could be used for athletes furnishing them in their diets. Practices like restricting energy intake, using severe weight-shedding practices, excluding one or more food groups or items from diet, consuming more of carbohydrate-rich diets with reduced micronutrient density could pose bigger risk of developing micronutrient deficiencies among the athletes. For this, they should consume diets providing at least the Recommended Dietary Allowances/ Dietary Reference Intakes RDAs/DRIs for ensuring that different micronutrients in the food are reaching to the body.

Adequate intake of liquids before, during and after exercise is crucial for optimal health and performance as dehydration decreases exercise performance. That is why athletes are advised to drink enough fluid to balance the fluid losses. They should consume 400 to 600 ml (14 to 22 oz) of fluid two hours before exercise and another 150 to 350 ml (6 to 12 oz) of fluid contents should be taken in every 15 to 20 minutes while doing the exercise depending up on its tolerance (i.e. frequency, intensity and duration of the exercise). Once an exercise gets over, it highly advisable for an athlete to drink adequate quantity of fluids to replace exhausted mineral and electrolytes with sweat losses occurred while exercising. At least 450 to 675 ml (16 to 24 oz) of fluid intake is again suggestible for every pound (0.5 kg) of body weight to replenish as it gets lost during exercise through perspiration. Meal/snack provided before exercise should consist of sufficient amounts of fluid for maintaining hydration levels, optimally. Such items should be relatively low in fat and fiber as then it enables gastric emptying and reduced gastro-intestinal distresses. Rather the diet should be relatively carbohydrate rich enough to promote proper maintenance of glucose concentration in bloodstream. In addition to this, the diet requires being moderately rich in proteins and composed of foods familiar and well tolerated by the athlete's body and digestive tract.

In nutrient consumption the primary goal during exercise is to maintain the blood glucose levels by replenishing fluid and essential-mineral losses and further supply sufficient carbohydrates (approximately 30 to 60 g per h) to the active ends and muscles in body. All of these guidelines about the

nutritional know-how are important, especially for endurance events that may generally last for longer than an hour. Following these nutritional cautions is even more vital when the athlete could not consume adequate food or fluid before starting with their exercise. It is instrumental to abide by these guidelines when the athlete is exercising in an extremely distressing environment (that could be heat, cold or altitude). Major dietary goal, after exercise, is to keep offering sufficient dynamism from the carbohydrates count for ensuring rapid recovery and regain of muscular glycogen. Carbohydrate intake of 1.5 g/kg of body weight during the first 30 minutes is much-needed when the athlete is glycogen-depleted after an exercise and then again after every 2 hours for 4 to 6 hours is sufficient for replacing the glycogen stores. Protein consumed during an exercise or after an exercise generates amino acids for building and repairing tissues at different muscular regions. Therefore soon after a strenuous competition or training session athletes should willingly consume a mixed or what is generally known as the 'balanced' meal that must be supplying enough carbohydrates, protein and fat.

It implies that no extra vitamin and/or mineral supplements would actually be required if the athlete takes necessary energy share from various food items, ultimately contributing to the maintenance of ideal body weight with respect to the concerned sports/activity. Supplementation recommendations unrelated to exercise demands such as those for folic acid use in women of childbearing potential and among others requiring it should be followed, if needed. A multivitamin/mineral supplement is the most appropriate demand for if an athlete is following diet planning and charting/looking for eliminating foods or food groups when unwell or recovering from any sort of injury, or bearing some specific micronutrient deficiency. No supplementation of nutrients is advisable except for specific medical or nutritional reason/ prescription such that in the case of iron deficiency anemia where iron supplements are prescribed and used to reverse its affects.

It is here that the athletes should be counseled about utilising nutritional 'ergogenic' aids and assistance; that must be employed with great caution. It should only after careful evaluation of such products on the grounds of their safety, efficacy, potency as well as legality affairs that they can be utilised. It is only after careful review of health, diet, supplement and drug use, and energy requirements of the athlete by a qualified nutrition expert that the nutritional advice is provided and should be seek upon. On dietary grounds, vegetarian athletes have been found at a higher risk for being a deficient of energy, protein contents and other vital micronutrients. It is mainly attributed to the tendency of high intakes of low-energy-dense foods and the exclusion of meat and dairy foodstuffs from essential meals and diet. Consultation with a registered dietitian for possible substitutes of the lacking nourishment could help to avoid these nutritional problems.

11.4 RELATION BETWEEN BODY PHYSIQUE AND COMPOSITION WITH PERFORMANCE

Athletes meant for a specific sport denote a unique body composition. Athletic talent, accomplishments and propensity for a particular sport greatly depend upon physical characteristics, proportionalities and body composition that are instrumental to refine and to be worked upon. Sports persons and athletes have a different physiology and health consequences associated with their body composition compared to the non-athletic group. Body composition acts as a predictor of athletic performance. Ratios of different body dimensions with stature are extremely vital in sports as for they are related to a person's physical ability to meet the biomechanical demands of a particular sport or the playing position. Body weight and fat percentage, at extreme levels, associates with declining/negative sports performance, whereas, fat-free mass specifically muscle mass relates closely with highly refined performance. Quality of an individual's movement and efficiency of skills about its utilization is directly proportional to the level of performance.

Body fat percentage is noteworthy in endurance events. Extra fat intensifies the demand of energy needed for functioning without giving any extra energy in return. Excess fat at a given level of applied force resists change in velocity. So, excess of fat adds non-force producing mass to total body weight, eventually reducing performance. Body composition trends hence, help in categorising the potential of participants for particular sports event. Body mass index is used widely among adults for clinical and epidemiological assessments. However, it is important to note here that BMI is influenced by both fat mass and fat free mass. Most of the heavy weight boxers are overweight according to BMI standards but not fat. This is the reason BMI alone is not a reliable index for assessment of the status of body constitution of a sports person. On the other hand, skinfold thicknesses are much easier and economical to obtain, constituting part of subcutaneous fat density used to predict total body fat; forming about half of the total body fat percentage ratio.

Studies conducted over Olympic players indicated that successful sports performance is often obstructed by lack of appropriate physique. Morphological optimisation is associated with success in different sports. Studies on athletes have revealed sprinters are usually muscular, while marathon runners are small in size and leaner. Throwers are taller and heavier, with higher levels of fat being favorable for their excellence. Defensive linemen in football tend to have higher body fat than defensive backs. In track and field events, sprinters are supposed to have lower body fat than a thrower. Having higher body fat and body mass is supported among the athletes involved in events like swimming and kayaking. Athletes trained in weight bearing, or anaerobic sports like running/sprinting, it is instrumental for them to have much lower body fat percentage.

In sports specifically requiring body projection such as jumping movements against gravity, excess fat and body weight has been found hampering sports

performance. For long distance swimming and water polo, moderate level of fat is considered as an asset to performance as it provides additional buoyancy. This is the reason elite swimmers have optimal level of fat in their body. Jumpers are selected and later trained mainly for their long legs, short trunk and broader feet because height and long legs help them to have their center of gravity at a higher level which helps them in crossing greater height. Power to weight ratio is significant for jumpers, thence maximizing muscle mass and maintaining low body fat level is desirable. Throwers are must to have greater body weight because when an object is thrown forward and upward, an equal and opposite force is exerted on the thrower which disturbs his/her body balance. Effect of this reaction will consequently be more if the athlete does not have higher body weight. Further to make the flight of the throwing object longer in air, greater height is also advantageous for such athletes. Height gives an edge to basketball and volleyball players helping them to excel as it is an advantageous factor for these players.

It has been witnessed that shorter body frame helps athletes to excel in the field of gymnastics, weight-lifting class in boxing. China, Korea and Japan have produced more sports persons in the field of gymnastics as shorter height is more favorable in gymnastics. In the field of throwing events and heavy weight class in boxing bulky musculature helps the sports person in bringing laurels. Europeans have proved their sports acumen in volleyball, basketball, swimming, long jump, shot-put; credited to their taller height.

Check Your Progress 2

2) What is the importance of body composition in performance?

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3) Name the components taken care of in body composition.

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4) Why body fat is not favourable in performance activities?

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11.5 ROLE OF NUTRITION IN PERFORMANCE

High physical activity based performances are feasible only with the procurement of considerable amount of energy and essential macronutrients, in advance. Here carbohydrate based energy and protein intake demands specially must be addressed wisely to uphold the standard body weight, replenish the depleted glycogen reserves stored in body and offer ample of proteins for the maintenance and restoration of used and worn-out tissues and muscles. Intake of fatty contents monitored carefully, has to be plenty enough to endow the body with all the essential fatty acids and fat soluble vitamins, crucial for upholding sufficient stock of energy for maintenance of weight. So, overall diets given to athletes should provide them with moderate amounts of energy from fat, i.e. up to 20% to 25% of energy. Body weight and composition though tend to affect performance during exercise but that should not be considered as the only criterion for gauging performance in sports; hence daily weighing should be avoided.

Having sufficient energy and fluid content before an exercise, during its achievement and after its completion has crucial role to play in maintaining the well-being and enhancing performance of player. This ensures retaining normal blood glucose concentrations during exercise, which thus maximises exercise performance and improves recovery time from the mechanically stressful event. Athletes should be taken care for being well hydrated before beginning with the exercise. To balance the fluid losses they must drink adequate amount of fluid during and after exercise. During exercise muscles must be provided with required amount of fuel, blood glucose and thirst mechanism needs to be maintained so as to decrease risk of dehydration or hyponatremia. Sport drinks containing carbohydrates and electrolytes can be consumed for this. Athletes do not need any further vitamin and mineral supplementation if an adequate amount of energy, to keep up with an appropriate body weight, is consumed from various sources and foods. However, additional supplements may be needed by those specifically restricting their energy intake by employing severe weight loss practices and also the ones looking at eliminating one or more food groups completely from their diet. Moreover those consuming foods high on carbohydrates but lower micronutrient density would specially need to rely upon additional supplementation, for sure.

The effects of nutrition on exercise performance have been clearly documented in various researches. Whatever an athlete eats or drinks, undoubtedly it has an impact over their health, body physique and composition, substrate the exercise duration, its recovery time and ultimately the performance too. For optimisation of exercise performance one needs to follow good nutrition and hydration practices, follow careful use of ergogenic aids and supplements, avoid severe weight shedding practices and eat foods from different sources in adequate measures. Addressing nutritional and energy needs holds a priority for athletic performers. An efficient energy-balance is crucial to maintain optimal tissue masses, immune functions and desired athletic performance. Energy balance refers to the state when energy intake meaning the sum of energy gained from food, fluids and supplements

gets equal to the energy expenditure which is the sum of energy expended at basal metabolism by the 'thermic' effect of food as a result of digestive processes and any form of voluntary physical activity, if undertaken. Energy intakes when remain inadequate relative to the magnitude of energy to be expended leads to compromising with desirable performance results and benefits associated with the training regimes. Fat masses are used by the body as reservoirs of fuel when there are limited energy intakes. This is the time when loss of muscle in such situations takes place which then results into the loss of muscular strength and endurance. Continual low energy intake after a point of time will lead to deficiency of nutrients, particularly of the essential micronutrients.

RDAs' (Recommended Dietary Allowances, 2010) mean energy requirements put forth for women and men who are just slightly to moderately active in 19 to 50 years of age are defined as 2,200 and 2,900 kcal per day, respectively. For normally active people, they are counseled to consume an energy equivalent of 1.5 to 1.7 times of resting energy expenditure or at a rate of 37 to 41 kcal/kg of the body weight, per day. Expenditure of energy is under constant influence from heredity, age, sex, body size and composition, the intensity, frequency and duration of exercise. These numeric guidelines for energy intake can ultimately only estimate a crude approximation of the average energy requirements of an individual athlete that does not fit to the other performer, as one solution here does not fit all.

Every athlete must consume sufficient energy contents to maintain appropriate weight and body composition essential while obtaining training for a particular kind of sport. Usual energy intakes recommended for male endurance athletes ranges between 3,000 to 5,000 kcal on per day basis. And for female athletes, though the usual energy intakes (per kg of body weight) are dependent upon the training regimens intensely match those of male athletes, but some female athletes consume lesser energy sources than they expend. Such low energy intakes, like less than 1,800 to 2,000 kcal per day, over a longer run tend to cause reduction in weight. Resistance exercises usually require less energy than endurance exercises. But the total energy demand of athletes, for their increased body size and high levels of fat free mass, participating in strength training and body-building may be as high as those of endurance athletes. Instances where an increased lean body mass is the prime goal, energy intakes must be considered sufficient to meet the needs for growth of the respective muscles, that is why many of the strength athletes need is about 44-50 kcal/kg body weight on per day base, while those in serious training may have and experience even much higher energy requirements; even more than 50 kcal/kg body weight per day!

Physical activity, exercise/activity performance and finally swift recovery from exercise test phase could be improved a lot by optimal nutrition it has been suggested by the 'American Dietetic Association', the 'Dietitians of Canada' and the 'American College of Sports Medicine'. These organisations have actually provided recommendations for selecting food and fluids appropriately. Timing of food intake and supplement choices are highly significant for achieving optimal health and exercise performance. However, sport nutrition experts can further modify these general recommendations to

meet even the unique concerns of individual athletes about matters like health and well-being, sports, nutritional needs, dietary preferences, and body weight and composition goals.

Check Your Progress 3

5) Briefly describe the role of nutrition in performance.

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6) Which component of diet does not hold any nutritive value?

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11.6 SUMMARY

There are various factors which affect performance in sports and games-physique, training, skill, age, motivation, etc. physique is the most fundamental of all the factors. The physique of an individual can be evaluated from body dimensions, proportions, components and by somatotyping. To excel in a physically competitive sport, the player must possess dimensions of body characteristics which suit in his/her sport. It is because of this reason; the kinanthropometric or physical characteristics are known to be of fundamental importance for individual development to achieve high level performance in sports. Physical activity, athletic performance and recovery from exercise relating stress can be improved upon by optimum nutritional intakes. As part of nutritional conditioning, suitable selection of foodstuffs and liquids, timings of their intake and supplement nutrition choices is crucial for achieving optimal health and exercise performance.s

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11.8 HINTS/ANSWERS TO CHECK YOUR PROGRESS

1) Somatotyping is important for examining developmental dynamics of specific shape and size of human body, in accordance with the function of skill and training, for both competitive and leisure time phases. It also helps to decide whether a performer would be suitable to participate in the particular type of sport/activity with their body profile.

2) Body composition is an important tool for evaluating their health, for monitoring the effects of training program and to decide upon the optimal competitive body weight and other components of body composition.

3) Fat mass, fat free mass-muscles, bones, water

4) Extra fat increases the demand of energy needed for running without giving any extra energy in return. Lean body mass, on the other hand, acts as a better predictor of performance than fat mass in strength events. Excess of body fat has harmful effects on the performance in most of the sports whereas, fat free body mass, specifically muscle mass, and is generally related with highly refined performance.

5) Nutrition is vital to maintain the optimal lean tissue mass, immune and reproductive functions; and desired athletic performance.

6) Water

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