

UNIT ONE

CONCEPTS OF PHYSICAL FITNESS

1.1. Meanings and Definitions of Terms

1.1.1 Physical fitness

It is an ability to meet the ordinary, as well as unusual demands of daily life safely and effectively without being overly fatigued.

Simply it is the body's ability to function effectively and efficiently, and contributes the total quality of life.

The totally fit person has a healthy and happy outlook towards life.

Physical fitness is essential for human beings to adjust well with his environment as his mind and body are in complete harmony.

The multi-dimensional characteristics of physical fitness can be divided into two areas: health related physical fitness and skill related physical fitness

- health related physical fitness

- Cardiorespiratory
- Muscular endurance
- Muscular strength
- Flexibility
- Body composition

- skill related physical fitness

- ❖ Speed
- ❖ Strength
- ❖ Power
- ❖ Agility
- ❖ Balance
- ❖ Coordination

Physical fitness

- Clarke and Clarke (1989) found that physical fitness is not a static factor and it varies from individual to individual and in the same person from time to time depending on factors.
- United States president's Council on physical fitness and sports defined the terms “physical fitness as the ability to carry out daily task with vigour and alertness, without undue fatigue, with ample energy to enjoy leisure time pursuits.

1.1.2 Physical Activity

It is bodily movement produced by skeletal muscles that results in energy expenditure. The term, physical activity, does not require or imply any specific aspect or quality of movement.

The term encompasses all types, intensities, and domains. Although the term “physical activity” has been used often as a short-hand description for moderate-to-vigorous-intensity forms of physical activity.

Based on predominant physiologic effect, physical activity can be categorized in to **aerobic physical activity and anaerobic physical activity.**

Aerobic and anaerobic physical activities

- Aerobic physical activity includes forms of activity that are intense enough and performed long enough to maintain or improve an individual's cardiorespiratory fitness.
- Aerobic activities such as walking, basketball, soccer, or dancing, commonly require the use of large muscle groups
- Technically, aerobic physical activity includes any activity that could be maintained using only oxygen-supported metabolic energy pathways and could be continued for more than a few minutes.

Cont,

- Anaerobic physical activity refers to high-intensity activity without oxygen-supported metabolic energy pathways.
- Anaerobic activity can be maintained for only about 2 to 3 minutes. Sprinting and power lifting are examples of anaerobic physical activity.

Aerobic and anaerobic

► **Aerobic Exercise:**

Exercise that requires oxygen to produce the necessary energy (ATP) to carry out the activity

AEROBIC

► **Anaerobic**

Exercise: Exercise that does not require oxygen to produce the necessary energy (ATP) to carry out the activity

ANAEROBIC

Aerobic and anaerobic

- ▶ Higher maximal oxygen uptake
- ▶ Increase in the oxygen-carrying capacity of the blood
- ▶ Decrease in resting heart rate and an increase in cardiac muscle strength
- ▶ Lower heart rate at given workloads

Aerobic

- ▶ Increase in number and size of the mitochondria
- ▶ Increase in the number of functional capillaries
- ▶ Faster recovery time
- ▶ Lower blood pressure and blood lipids
- ▶ An increase in fat-burning enzymes

Anaerobic

1.1.3 Physical Exercise

- The term "exercise" has been used interchangeably with "physical activity", and, in fact, both have a number of common elements. For example, both physical activity and exercise involve any bodily movement produced by skeletal muscles that expends energy.
- Exercise is physical activity that is **planned, structured, repetitive, and purposive** in the sense that improvement or maintenance of one or more components of physical fitness is an objective.
- The formula relating physical activity and exercise is:
- $\text{kcalExercise} + \text{kcalNonexercise} = \text{kcalTotal daily Physical activity}$

- Generally, Exercise describes as planned structured and repetitive bodily movement done to improve or maintain one or more components of physical fitness and is subset of physical activity.
- Exercise is usually goal related and designed in the sense that the improvement or maintenance of one or more components of physical fitness (i.e., endurance, strength, flexibility

1.1.4 Sport

- It is an organized, competitive form of play
- When we refer to sport as “organized” competitive activity, we mean that the activity has been refined and formalized to some degree—that is, some definite form or process involved.
- Rules, whether they are written or not, are involved in this form of activity,
- We cannot think of sport without thinking of competition, for without the competition, sport becomes simply play or recreation.
- Play is amusement that used for enjoyment or pass leisure time.

1.2 General Principles of Fitness Training

- The human body adapts well when exposed to stress. The term stress, within the context of exercise, is defined as an exertion above the normal, everyday functioning.
- The specific activities that result in stress vary for each individual and depend on a person's level of fitness.
- Knowing a little about these principles provides valuable insights needed for organizing an effective fitness plan.

Principle cont,

- Types and number of principle of training vary from literature to literature. But the following principle of training are common in most sport.

A. Principle of overload

B. Principle of progression

C. Principle of FITT(Frequency, Intensity, Time & Type)

D. Principle of Rest, Recovery, and Periodization

E. Principle of Reversibility

F. Principle of Individual Differences

G. Principle of Specificity

H. Principle of variation

I. Principle of warm-up and cool-down

Principle of overload

- As a result of the adaptation, more stress than the usual must be applied to the system in order to stimulate improvements, a principle known as the **overload principle**.
- Consider the old saying, “No pain, No gain.” Does exercise really have to be painful, as this adage implies, to be beneficial? Absolutely not.
- Physical stress, such as walking at a brisk pace or jogging, places increased stress on the regulatory systems that manage increased heart rate and blood pressure, increased energy production, increased breathing, and even increased sweating for temperature regulation.

- For example, a beginning weightlifter performs squats with 10 repetitions at 150 pounds. After 2 weeks of lifting this weight, the lifter notices the 150 pounds feels easier during the lift and afterwards causes less fatigue. The lifter adds 20 pounds and continues with the newly established stress of 170 pounds.
- This same principle can be applied, not only to gain muscular strength, but also to gain flexibility, muscular endurance, and cardiorespiratory endurance.

Overload can be progressed by:

- Increasing the resistance e.g. adding 5kg to the barbell
- Increasing the number of repetitions with a particular weight
- Increasing the number of sets of the exercise (work)
- Increasing the intensity- more work in the same time, i.e. reducing the recovery periods

FITT Principle

- In exercise, the amount of stress placed on the body can be controlled by four variables: Frequency, Intensity, Time (duration), and Type, better known as FITT. The FITT principle, as outlined by the American College of Sports Medicine (ACSM) falls under the larger principle of overload.
 - Frequency- how often the exe.
 - Intensity- how hard the exe.
 - Time- how long the exe.
 - Type- how vary the exe.

A. Frequency and Time

- Each variable can be used independently or in combination with other variables to impose new stress and stimulate adaptation. Such is the case for frequency and time.
- Frequency relates to how often exercises are performed over a period of time. In most cases, the number of walking or jogging sessions would be determined over the course of a week
- The duration of exercise, or time, also contributes to the amount of stress experienced during a workout. Certainly, a 30-minute brisk walk is less stressful on the body than a 4-hour marathon.

B. Type of Exercise

- Simply put, the type of exercise performed should reflect a person's goals.
- In cardiorespiratory fitness, the objective of the exercise is to stimulate the cardiorespiratory system. Other activities that accomplish the same objective include swimming, biking, dancing, cross country skiing, aerobic classes, and much more.
- type and the principle of specificity, a few additional items should be considered. Stress, as it relates to exercise, is very specific. There are multiple types of stress. The three main stressors are metabolic stress, force stress, and environmental stress

C. Intensity

- Intensity, the degree of difficulty at which the exercise is carried out, is the most important variable of FITT.
- More than any of the other components, intensity drives adaptation. Because of its importance, it is imperative for those beginning a fitness program to quantify intensity, as opposed to estimating it as hard, easy, or somewhere in between.
- How then can intensity be measured? Heart rate is one of the best ways to measure a person's effort level for cardiorespiratory fitness.

1.2.3 Principle of Rest, Recovery, and Periodization

The principle of rest and recovery (or principle of recuperation) suggests that rest and recovery from the stress of exercise must take place in proportionate amounts to avoid too much stress.

. One systematic approach to rest and recovery has led exercise scientists and athletes alike to divide the progressive fitness training phases into blocks, or periods.

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This training principle, called periodization, is especially important to serious athletes but can be applied to most exercise plans as well.

The principle of periodization suggests that training plans incorporate phases of stress followed by phases of rest.

Training phases can be organized on a daily, weekly, monthly, and even multi-annual cycles, called micro-, meso-, and macrocycles, respectively. An example of this might be:

- Periodization Example

Week	Frequency	Intensity	Time	Type
1	3 days	40% HRR	25 min	Walk
2	4 days	40% HRR	30 min	walk
3	4 days	50% HRR	35 min	walk
4	2 days	30% HRR	30 min	other

Without periodization, the stress from exercise would continue indefinitely eventually leading to fatigue, possible injury, and even a condition known as **overtraining syndrome**

Symptoms of overtraining include the following:

- weight loss
- loss of motivation
- inability to concentrate or focus
- feelings of depression
- lack of enjoyment in activities normally considered enjoyable
- sleep disturbances
- change in appetite

1.2.4 Principle of Reversibility

- Chronic adaptations are not permanent. As the saying goes, “Use it or lose it.” The principle of reversibility suggests that activity must continue at the same level to keep the same level of adaptation. As activity declines, called detraining, adaptations will recede.

1.2.5 Principle of Individual Differences

- While the principles of adaptation to stress can be applied to everyone, not everyone responds to stress in the same way.
- Along with other studies, this has led researchers to believe individual differences in exercise response are genetic. Some experts estimate genes to contribute as much as 47% to the outcome of training.
- In addition to genes, other factors can affect the degree of adaptation, such as a person's age, gender, and training status at the start of a program.

UNIT TWO

THE HEALTH BENEFITS OF PHYSICAL ACTIVITY

Unit objectives

By the end of this unit students should be able to:

- Describe the health benefits of physical activity
- Identify diseases which are associated with a sedentary lifestyle and the major risk factors for these diseases
- Realize regular physical activity in terms of disease prevention and healthy aging?
- Estimate physical activity needed for improved health benefits?
- Identify physical activities suitable for typical people, and how often should they exercise?

INTRODUCTION

- Physical activity and physical fitness have been linked with health and longevity since ancient times.
- The earliest records of organized exercise used for health promotion are found in China, around 2500 BC.
- the Greek physicians of the fifth and early fourth centuries BC who established a tradition of maintaining positive health through 'regimen'; the combination of correct eating and exercise

Hippocrates (460–370 BC), often called the Father of Modern Medicine, wrote all parts of the body which have a function, if used in moderation and exercised in labours in which each is accustomed.

2.1. Physical Activity and Hypokinetic Diseases/ Conditions

Hypokinetic diseases are conditions related to inactivity or low levels of habitual activity.

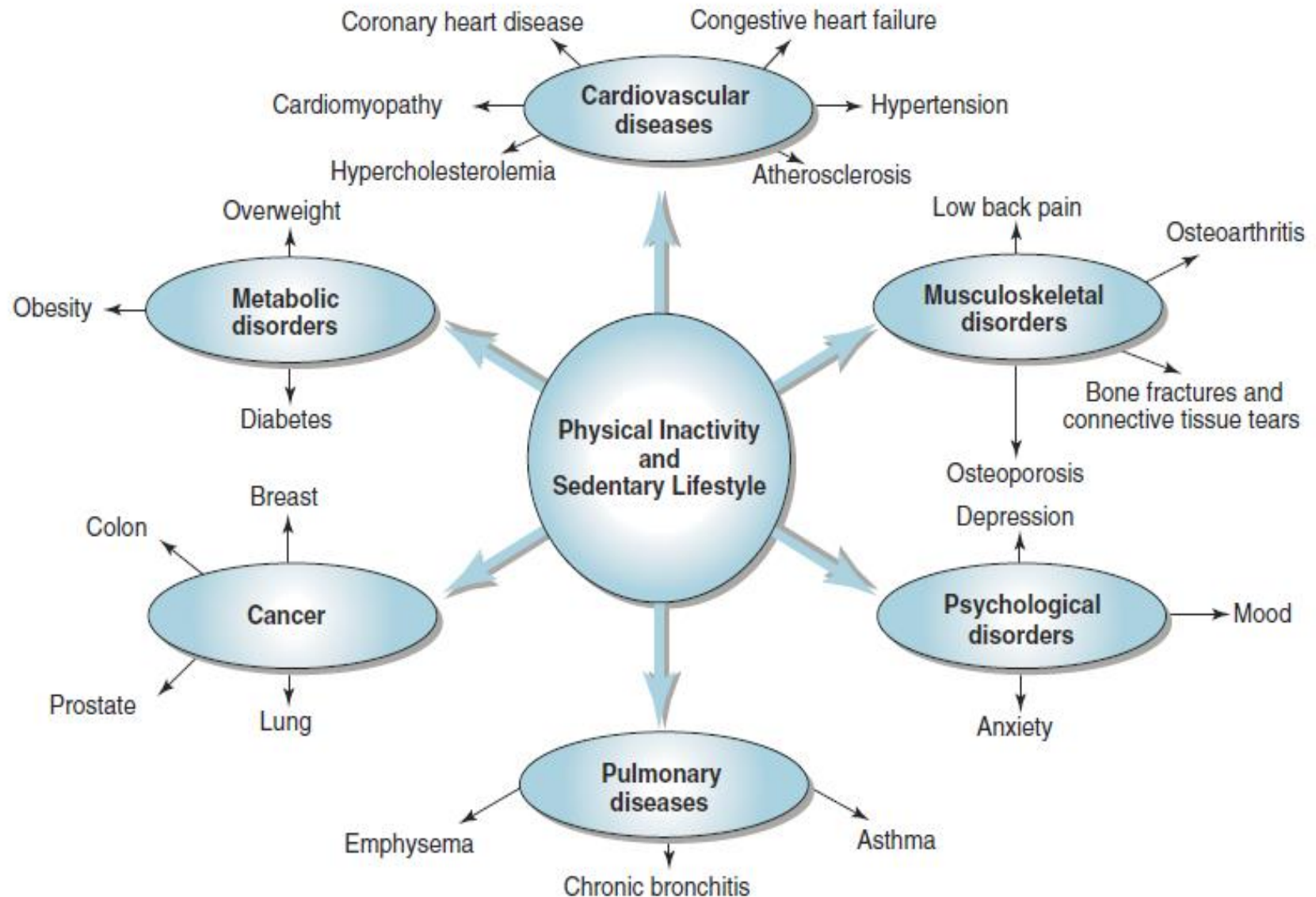
The term “hypokinetic” was coined by Kraus and Raab in their book *Hypokinetic Disease* (Kraus & Raab, 1961).

This term is now widely accepted and can be used to describe many of the diseases and conditions associated with inactivity and poor fitness such as those conditions outlined in *Physical Activity and Health: A Report of the Surgeon General* (USDHSS, 1996).

Individuals who do not exercise regularly are at a greater risk for developing chronic diseases such as:-

- coronary heart disease (CHD),
- hypertension,
- hypercholesterolemia,
- cancer,
- Metabolic disordered
- Psychological disordered
- obesity, and
- musculoskeletal disorders

Role of physical activity and exercise in disease prevention and rehabilitation



Exercise scientists and health and fitness professionals have maintained that regular physical activity is the best defence against the development of many diseases, disorders, and illnesses.

Scientific evidence has increased our understanding of the benefits of physical activity for improved health and quality of life.

The intensity of exercise is expressed in metabolic equivalents (METs).

A MET is the ratio of the person's working (exercising) metabolic rate to the resting metabolic rate.

One MET is defined as the energy cost of sitting quietly.

Summary of the ACSM and AHA physical activity recommendations for adults

	AEROBIC ACTIVITY ^a			MUSCLE-STRENGTHENING ACTIVITY			FLEXIBILITY/ BALANCE ACTIVITY
Population group	Duration ^b (min/day)	Intensity	Frequency (days/wk)	Sets	Intensity or # of exercises	Frequency (days/wk)	
Healthy adults 18-65 yr	30	Moderate (3.0–6.0 METS)	Minimum 5	1	8- to 12-RM; 8–10 exercises for major muscle groups	≥2 noncon- secutive days	No specific recommendation
	20	Vigorous (>6.0 METS)	Minimum 3				
Older adults >65 yr	30	Moderate (5 or 6 on 10 pt. scale)	Minimum 5	1	10- to 15-RM; 8–10 exercises for major muscle groups; Moderate intensity (5 or 6 on 10 pt. scale) Vigorous intensity (7 or 8 on 10 pt. scale)	2 nonconsec- utive days	For flexibility at least 2 days per wk for at least 10 min each day; include balance exer- cises for those at risk for falls.
	20	Vigorous (7 or 8 on 10 pt. scale)	Minimum 3				

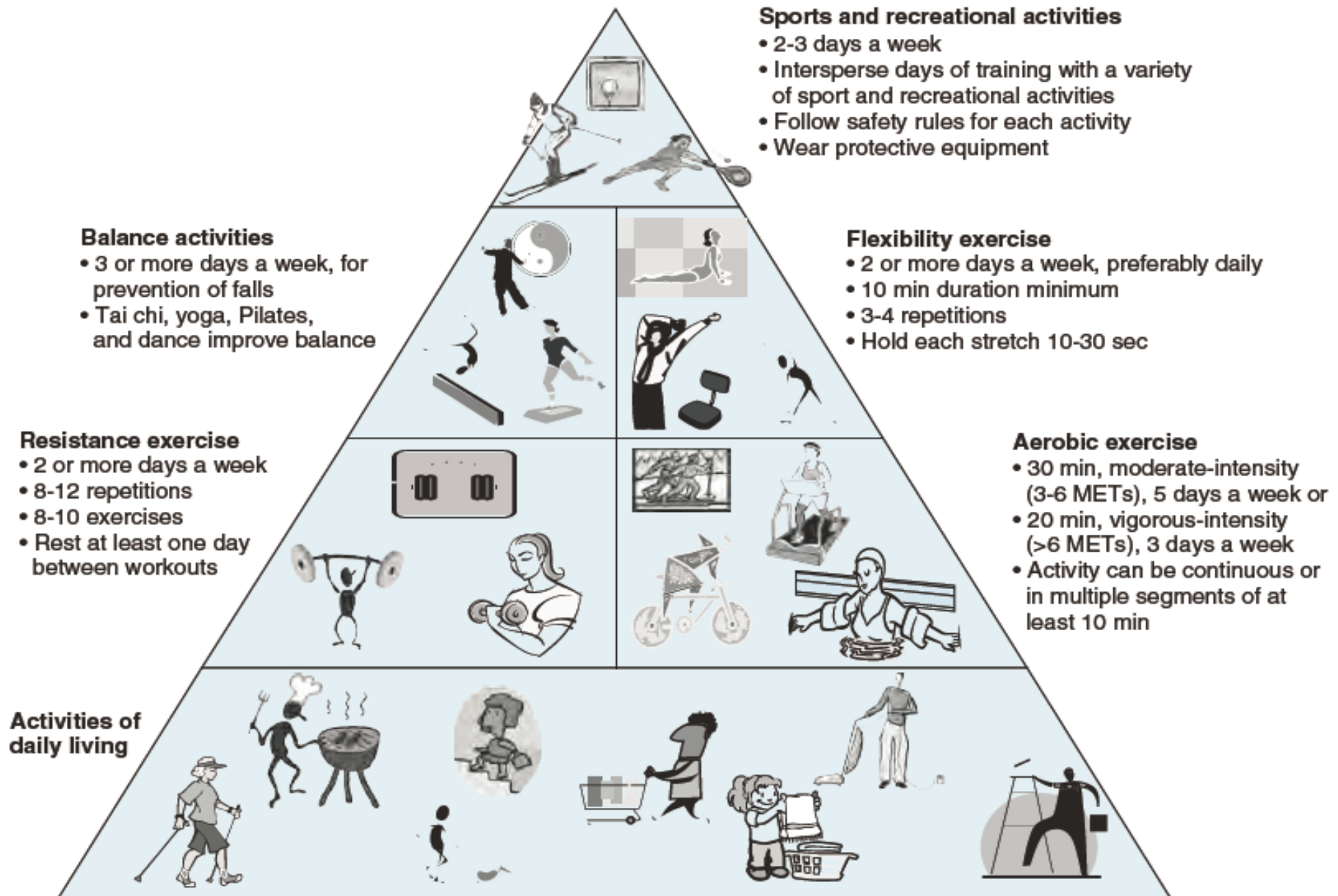
- Improvements in health benefits depend on the volume (i.e., combination of frequency, intensity, and duration) of physical activity. This is known as the dose-response relationship.
- Physical activity lowers the risk of hypokinetic conditions including:-
 - dying prematurely,
 - coronary artery disease,
 - stroke,
 - type 2 diabetes,
 - metabolic syndrome,
 - high blood lipid profile,
 - cancers (colon, breast, lung, and endometrial), and
 - hip fractures

- For adults (18–65 yr) and older adults (>65 yr), the ACSM recommends a minimum of 30 min of moderate-intensity aerobic activity 5 days per week or 20 min of vigorous-intensity aerobic exercise 3 days per week.
- They also recommend moderate- to high-intensity (8- to 12-repetition maximum (RM) for adults and 10- to 15-RM for older adults) resistance training for a minimum of 2 non-consecutive days per week.
- Balance and flexibility exercises are also suggested for older adults.

- The Exercise and Physical Activity Pyramid illustrates a balanced plan of physical activity and exercise to promote health and to improve physical fitness.
- You should encourage your clients to engage in physical activities around the home and workplace on a daily basis to establish a foundation (base of pyramid) for an active life style.
- They should perform aerobic activities a minimum of 3 days/wk; they should do weight-resistance exercises and flexibility or balance exercises at least 2 days per week.

- Low intensity physical activities (bottom of pyramid) require light physical exercise.
- Recreational sport activities (middle levels of pyramid) are recommended to add variety to the exercise plan.
- High-intensity training and competitive sport (top of pyramid) require a solid fitness base and proper preparation to prevent injury; most adults should engage in these activities sparingly

The Exercise and Physical Activity Pyramid



Physical Activity and Cardiovascular Diseases

- According to World Health Organization (WHO, 2011) cardiovascular disease (CVD) caused 17.3 million deaths (30%) worldwide in 2008, and it is projected to cause more than 26 million deaths by 2030.
- More than 80% of those cardiovascular deaths occurred in low- and middle-income countries.

Coronary Heart Disease (CHD)

- CHD is caused by a lack of blood supply to the heart muscle (myocardial ischemia) resulting from a progressive, degenerative disorder known as atherosclerosis.
- Atherosclerosis is an inflammatory process involving a build-up of low-density lipoprotein (LDL) cholesterol, scavenger cells (monocytes), necrotic debris, smooth muscle cells, and fibrous tissue.
- This is how plaques form in the intima, or inner lining of the medium- and large-sized arteries throughout the cardiovascular system

- Coronary Heart Disease Risk Factors: The greater the number and severity of risk factors, the greater the probability of CHD. The positive risk factors for CHD are:
 - Age,
 - Family History,
 - Hypercholesterolemia,
 - Hypertension,
 - Tobacco use,
 - Diabetes Mellitus or Prediabetes,
 - Overweight and Obesity, and
 - Physical Inactivity.

- Physical Activity and Coronary Heart

Physically active people have lower incidences of myocardial infarction and mortality from CHD and tend to develop CHD at a later age compared to their sedentary counterparts.

Individuals who exercise regularly reduce their relative risk of developing CHD by a factor of 1.5 to 2.4. Leading a physically active lifestyle may prevent 20% to 35% of cardiovascular diseases.

Hypertension

- Hypertension, or high blood pressure, is a chronic, persistent elevation of blood pressure that is clinically defined as a systolic pressure ≥ 140 mmHg or a diastolic pressure ≥ 90 mmHg.
- Regular physical activity prevents hypertension and lowers blood pressure in younger and older adults who are normotensive, prehypertensive, or hypertensive

Hyper-cholesterolemia and Dyslipidemia

- Hypercholesterolemia, is an elevation of total cholesterol (TC) in the blood, is associated with increased risk for CVD.
- Hypercholesterolemia is also referred to as hyperlipidemia, which is an increase in blood lipid levels;
- dyslipidemia refers to an abnormal blood lipid profile.
- Age, gender, family history, alcohol, smoking are risk factors for hypercholesterolemia and regular activity reduced the chance of getting hypercholesterolemia and hyslipidemia.

- LDLs, HDLs, and TC: Cholesterol is a waxy, fatlike substance found in all animal products (meats, dairy products, and eggs). The body can make cholesterol in the liver and absorb it from the diet.
- Lipoproteins are classified by the thickness of the protein shell that surrounds the cholesterol.

- The four main classes of lipoproteins are chylomicron, derived from the intestinal absorption of triglycerides (TG);
- very low-density lipoprotein (VLDL), made in the liver for the transport of triglycerides;
- low-density lipoprotein (LDL), a product of VLDL metabolism that serves as the primary transporter of cholesterol; and
- high-density lipoprotein (HDL), involved in the reverse transport of cholesterol to the liver.

Diabetes Mellitus

Diabetes is a global epidemic. More than 346 million people worldwide have the disease (WHO, 2011).

Factors linked to this epidemic include urbanization, aging, physical inactivity, unhealthy diet, and obesity.

At least 65% of people with diabetes mellitus die from some form of heart or blood vessel disease (AHA, 2008).

Diabetes is a major contributor toward the development of CHD, stroke and kidney failure .

- Pre-diabetes, in addition to being a positive risk factor for CVD, is a medical condition identified by fasting blood glucose or glycated, hemoglobin (HbA1c) levels that are above normal values but lower than the threshold for a diagnosis of diabetes.
- Fortunately, pre-diabetes appears to respond favourably to weight loss and increases in physical activity.

- **Type 1 diabetes**, formerly referred to as insulin-dependent diabetes mellitus (IDDM), usually occurs before age 30 but can develop at any age.
- **Type 2 diabetes**, previously known as non-insulin-dependent diabetes mellitus (NIDDM), is more common; 90% of individuals diagnosed with diabetes mellitus worldwide have type 2 diabetes (WHO, 2011). Age, gender, family history, calorie intake, physical inactivity are risk factors for developing diabetes.

Type 1 diabetes may be caused by autoimmune, genetic, or environmental factors, but the specific cause is unknown. Unfortunately, there is no known way to prevent type 1 diabetes (CDC, 2011).

Healthy nutrition and increased physical activity, however, can reduce the risk of type 2 diabetes by as much as 67% in high-risk individuals.

Nearly 90% of cases of type 2 diabetes worldwide may be related to obesity

- The effect of exercise alone as an intervention for people with type 2 diabetes is not well researched. However, exercise (30–120 min, 3 days/wk for 8 wk) produced clinically significant improvements in HbA1c and reduced visceral and subcutaneous adipose tissue stores in people with type 2 diabetes.
- Both resistance and aerobic exercise alone or in combination improve HbA1c values in people with type 2 diabetes

Obesity and Overweight

- overweight and obesity are classified using the body mass index(BMI) ($BMI = \text{weight [kg]} / \text{height squared [m}^2\text{]}$).
- Individuals with a BMI between 25 and 29.9 kg/m² are classified as overweight; those with a BMI of 30 kg/m² or more are classified as obese.
- Age, gender, family history, cholesterol intake, and physical inactivity are the major factors associated with increased risk of obesity.

- Excess body weight and fatness pose a threat to both the quality and duration of one's life.
- Obese individuals have a shorter life expectancy and greater risks of CHD, stroke, dyslipidemia, hypertension, diabetes mellitus, certain cancers, osteoarthritis, sleep apnea, abnormal menses, and infertility.
- Restricting caloric intake and increasing caloric expenditure through physical activity and exercise are effective ways of reducing body weight and fatness while normalizing blood pressure and blood lipid profiles

Metabolic Syndrome

- Metabolic syndrome refers to a combination of CVD risk factors associated with hypertension, dyslipidemia, insulin resistance, and abdominal obesity.
- Age and BMI directly relate to metabolic syndrome
- Lifestyle must be modified in order to manage metabolic syndrome.
- The combination of healthy nutrition and increased physical activity is an effective way to increase HDL-C and to reduce blood pressure, body weight, triglycerides, and blood glucose levels.

Aging

- A sedentary lifestyle and lack of physical activity reduce life expectancy by predisposing the individual to aging-related diseases and by influencing the aging process itself.
- With aging, a progressive loss of physiological and metabolic functions occurs; however, biological aging may differ considerably among individuals due to variability in genetic and environmental factors that affect oxidative stress and inflammation.
- regular exercise benefits in retarding the aging process and diminishing the risk of aging-related diseases.

Physical Activity and Postural Deformity

- Posture is the position from which movement begins and ends.
- Having proper postural alignment enables the body to perform movements quicker with less joint and muscular strain.
- The body is designed to work at the most economical level, thus saving energy for future use.
- We spend more energy maintaining misaligned posture, which can cause muscle and joint pain.

- Women in general tend to develop poor posture because of many factors.
- They often have more clerical and computer oriented jobs that require sitting in a chair, eyeing a computer screen for long periods of time.
- They also wear high-heeled shoes, which lead to an alteration and compensation of their posture.
- To improve your posture and reduce structural damage, you should adhere to a corrective postural exercise program

Exercises for correcting posture:

- Prone Cobra
- Axial Extension Trainer
- Wall Leans
- Cervical Extension using a blood pressure cuff

Musculoskeletal Diseases and Disorders

- Diseases and disorders of the musculoskeletal system, such as osteoporosis, osteoarthritis, bone fractures, connective tissue tears, and low back syndrome, are also related to physical inactivity and a sedentary lifestyle.
- Osteoporosis is a disease characterized by the loss of bone mineral content and bone mineral density due to factors such as aging, amenorrhea, malnutrition, menopause, and physical inactivity

- Osteopenia, or low bone mineral mass, is a precursor to osteoporosis.
- Adequate calcium intake, vitamin D intake, and regular physical activity help counteract age-related bone loss.
- Exercise Prescription for Preserving Bone Health of Adults
 - Mode
 - Intensity
 - Frequency
 - Duration

Low back pain

- Low back pain afflicts millions of people each year. More than 80% of all low back problems are produced by muscular weakness or imbalance caused by a lack of physical activity.
- the muscles are not strong enough to support the vertebral column in proper alignment, poor posture results and low back pain develops.
- Excessive weight, poor flexibility, and improper lifting habits also contribute to low back problems

- While some risks of associated with low back pain are not modifiable, such as gender and age, lifestyle behaviour such as smoking, physical inactivity, flexibility, and muscular strength and endurance can all be improved.
- Because the origin of low back problems is often functional rather than structural, in many cases, the problem can be corrected through an exercise program that develops strength and flexibility in the appropriate muscle groups

UNIT THREE

MAKING WELL-INFORMED FOOD CHOICES

- **UNIT OBJECTIVES**

- By the end of this unit students should be able to:-
 - Summarize the basics of nutrition
 - Define macronutrients and micronutrients
 - Categorize and describe the body's sources of energy
 - Analyse intake of nutrition and make appropriate changes for sound eating practices
 - Realize the management of nutrition for better physical performance

Introduction

- Regular exercise taxes every cell and every system in your body: your muscles, joints, ligaments, tendons, respiratory, circulatory and immune systems all have to work harder when you exercise.
- Eating a healthy diet can help minimize the damage caused by exercise and help your body rebuild itself even stronger.

Sound Eating Practices

- What is Nutrition? And
- what is Nutrient?
- Nutrition can be defined as the science of the action of food, beverages, and their components in biological systems.
- A nutrient is a compound that provides a needed function in the body.
- Nutrients can be further classified based on the amount needed in the body.
- Macronutrients are the nutrients the body needs in larger amounts.
- Micronutrients are also important nutrients, but ones the body needs in smaller amounts.

- The food you eat is a source of nutrients.
Nutrients are defined as the substances found in food that keep your body functioning.
- Your body needs nutrients to...
- Fuel your energy.
- Help you grow.
- Repair itself.
- Maintain basic bodily functions

Macronutrients

- **Carbohydrates:** The word carbohydrate literally means "hydrated carbon," or carbon with water. Thus, it is no surprise that carbohydrates are made up of carbon, hydrogen, and oxygen.

Sucrose (table sugar) is an example of a commonly consumed carbohydrate. Some dietary examples of carbohydrates are whole-wheat bread, oatmeal, rice, sugary snacks/drinks, and pasta.

- Proteins:** Like carbohydrates, proteins are comprised of carbon, hydrogen, and oxygen, but they also contain nitrogen. Several dietary sources of proteins include nuts, beans/legumes, skim milk, egg whites, and meat.

Function in the Body:

Provides energy.

Help to build, maintain, and repair body tissues.

Proteins are made up of chemical compounds called amino acids. There are 20 amino acids.

Lipids: Lipids consist of fatty acids, triglycerides, phospholipids, and sterols (cholesterol). Lipids are also composed of carbon, hydrogen, and oxygen. Some dietary sources of lipids include oils, butter, and egg yolks.

- **Water:** Water is made up of hydrogen and oxygen and is the only macronutrient that provides no energy.

Micronutrients

- Vitamins: These compounds are essential for normal physiologic processes in the body.

Unlike carbohydrates, fats, and proteins, vitamins DO NOT provide energy (calories).

- Minerals: Minerals are the elements (think periodic table) that are essential for normal physiologic processes in the body.

Unlike carbohydrates, fats, and proteins, minerals DO NOT provide energy (calories).

Calories (Food Energy)

- Food energy is measured in kilocalories (kcal), commonly referred to as calories. Although technically incorrect, this terminology is so familiar that it will be used throughout this course.
- A kilocalorie is the amount of energy needed to raise 1 kilogram of water 1 degree Celsius. A food's kilocalories are determined by putting the food into a bomb calorimeter and determining the energy output:
- Energy = Measurement of Heat Produced. Below is a picture of a bomb calorimeter and a link to a video showing how one is used. The number of kilocalories per gram for each nutrient is shown below:

Amount of calories obtained from nutrients

<i>Nutrient</i>	<i>Energy (kcal/g)</i>
<i>Carbohydrate</i>	<i>4</i>
<i>Protein</i>	<i>4</i>
<i>Lipids</i>	<i>9</i>
<i>Water</i>	<i>0</i>
<i>Vitamins</i>	<i>0</i>
<i>Minerals</i>	<i>0</i>

carbohydrates, protein, and lipids provide energy. However, there is another dietary energy source that is not a nutrient— alcohol. To emphasize, alcohol is not a nutrient, but it does provide 7 kilocalories of energy per gram.

daily calorie needs will depend on your genetic make-up, age, weight, body composition, your daily activity and your training programme. It is possible to estimate the number of calories you need daily from your body weight (BW) and your level of daily physical activity.

Step 1: Estimate your Basal Metabolic Rate (BMR)

As a rule of thumb, BMR uses 22 calories for every kg of a woman's body weight and 24 calories per kg of a man's body weight.

Women: $\text{BMR} = \text{weight in kg} \times 22$

Men: $\text{BMR} = \text{weight in kg} \times 24$

Step 2: Work out your Physical Activity Level (PAL)

This is the ratio of your overall daily energy expenditure to your BMR; a rough measure of your lifestyle activity.

- Mostly inactive or sedentary (mainly sitting): 1.2
- Fairly active (include walking and exercise 1–2 x week): 1.3
- Moderately active (exercise 2–3 x weekly): 1.4
- Active (exercise hard more than 3 x weekly): 1.5
- Very active (exercise hard daily): 1.7

Step 3: Multiply your BMR by your PAL to work out your Daily Calorie Needs

- Daily calorie needs = $\text{BMR} \times \text{PAL}$
- This figure gives you a rough idea of your daily calorie requirement to maintain your weight. If you eat fewer calories, you will lose weight; if you eat more then you will gain weight.

I. Carbohydrates

- Carbohydrate is an important fuel for exercise. It is stored as glycogen in your liver and muscles, and must be re-stocked each day.
- Approximately 100 g glycogen (equivalent to 400 kilocalories) may be stored in the liver, and up to 400 g glycogen (equivalent to 1600 kilocalories) in muscle cells.
- The purpose of liver glycogen is to maintain steady blood sugar levels.

- The more active you are, the higher your carbohydrate needs. Guidelines for daily intakes are about 5–7 g per kg of body weight per day for moderate duration/low intensity daily training.
- Those who do moderate–heavy endurance training should consume 7–10 g per kg body weight per day; and those training more than 4 hours per day are advised to consume 10 g or more per kg body weight per day.

- During exercise lasting longer than 60 minutes, consuming 20–60 g carbohydrate per hour helps maintain your blood glucose level, delay fatigue and increase your endurance. Choose high GI carbohydrates (e.g. sports drinks, energy gels and energy bars, bananas, fruit bars, cereal or breakfast bars), which convert into blood sugar rapidly.

II. Protein

Protein is another major macronutrient that, like carbohydrates, consists of small repeating units. But instead of sugars, proteins are made up of amino acids.

Proteins can be classified as either complete or incomplete. Amino acids from proteins form the building blocks for new tissues and the repair of body cells.

They are also used for making enzymes, hormones and antibodies.

Protein also provides a (small) fuel source for exercising muscles.

- As protein is found in so many foods, most people, including athletes eat a little more protein than they need.
- This isn't harmful, the excess is broken down into urea (which is excreted) and fuel, which is either used for energy or stored as fat if your calorie intake exceeds your output.
- Several studies have found that carbohydrate and protein eaten together immediately after exercise enhances recovery and promotes muscle building

III. Fat

- Some fat is essential, it makes up part of the structure of all cell membranes, your brain tissue, nerve sheaths, bone marrow and it cushions your organs.
- Fat in food also provides essential fatty acids, the fat-soluble vitamins A, D and E, and is an important source of energy for exercise.
- about 20–33% of the calories in your diet should come from fat.

- ‘Bad’ fats (saturated and trans fats) should be kept to a minimum (the UK government recommends less than 10% of calories), with the majority coming from ‘good’ (unsaturated) fats.
- Omega-3s may be particularly beneficial for athletes as they help increase the delivery of oxygen to muscles, improve endurance and may speed recovery, reduce inflammation and joint stiffness.
- There is neither bad nor good cholesterol, despite the common use of these descriptions in reference to LDL and HDL, respectively.
- Cholesterol is cholesterol. HDL and LDL contain cholesterol but are actually lipoproteins

IV. Fiber

- The simplest definition of fiber is indigestible matter. Indigestible means that it survives digestion in the small intestine and reaches the large intestine. There are the three major fiber classifications:
- Dietary fiber: This type of fiber contains both non-digestible carbohydrates and lignin and is always intrinsic and intact in plants.
- Functional fiber: This type of fiber contains non-digestible carbohydrates only and can be isolated, extracted, or synthesized. Functional fiber can be from plants or animals and produces beneficial physiological effects in humans.
- Total Fiber: Fiber that contains both dietary fiber and functional fiber.

V. Vitamins

- Vitamins are organic compounds found in foods and are a necessary part of the biochemical reactions in the body.
- They are involved in a number of processes, including mineral and bone metabolism, and cell and tissue growth, and they act as cofactors for energy metabolism. The B vitamins play the largest role of any vitamins in metabolism.
- Vitamins are either fat-soluble or water-soluble. Fat-soluble vitamins A, D, E, and K, are absorbed through the intestinal tract with lipids in chylomicrons.
- Vitamin D is also synthesized in the skin through exposure to sunlight.

- Water-soluble vitamins, including the eight B vitamins and vitamin C, are absorbed with water in the gastrointestinal tract.
- These vitamins move easily through bodily fluids, which are water based, so they are not stored in the body. Excess water-soluble vitamins are excreted in the urine.

VI. Minerals

- Minerals in food are inorganic compounds that work with other nutrients to ensure the body functions properly.
- Minerals cannot be made in the body; they come from the diet
- most of that consists of the minerals that the body requires in moderate quantities: potassium, sodium, calcium, phosphorus, magnesium, and chloride.

- The most common minerals in the body are calcium and phosphorous, both of which are stored in the skeleton and necessary for the hardening of bones.
- Most minerals are ionized, and their ionic forms are used in physiological processes throughout the body.

VII. Water

- You should ensure you are hydrated before starting training competition and aim to minimize dehydration during exercise.
- Dehydration can result in reduced endurance and strength, and heat related illness.
- The IOC advises matching your fluid intake to your fluid losses as closely as possible and limiting dehydration to no more than 2% loss of body weight (e.g. a body weight loss of no more than 1.5 kg for a 75 kg person).

- Additionally, the IAAF cautions against overhydrating yourself before and during exercise, particularly in events lasting longer than 4 hours. Constantly drinking water may dilute your blood so that your sodium levels fall.
- Sports drinks are better than water during intense exercise lasting more than 60 minutes because their sodium content will promote water retention and prevent hyponatraemia.

Nutrition and Physical Performance

- There is universal scientific consensus that diet affects performance. A well-planned eating strategy will help support any training programme.
- everyone has different nutritional needs and there is no single diet that fits all.
- Some athletes require more calories, protein or vitamins than others; and each sport has its unique nutritional demands.
- Nutrition and physical performance will have three parts, these are: before(pre) exercise, during exercise and after(post) exercise

Nutrition before Training Exercise

- What you eat and drink the day before and during the several hours before your workout dictates how much energy you'll have for training and how well you will perform. It also affects how much body fat, glycogen or even muscle tissue you burn.
- Eating the right amount and type of carbohydrate as well as timing your pre-exercise meal correctly will help avoid common problems such as fatigue, dizziness, fainting and stitch.

❓ Why eat before training?

- The main purpose of your pre-workout meal is to stabilise your blood sugar levels during exercise.
- It also staves off hunger and minimises the risk of problems such as stitch and hypoglycaemia (low blood sugar levels).
- Pre-workout meal goal: maximize muscle & liver glycogen stores providing glucose.
- For most regular exercisers, a daily diet providing carbohydrates of around 280–350 g for a 70 kg person

- **❓ Should you train on empty?**
- It is definitely not advisable to train on an empty stomach.
- when your brain isn't getting enough fuel you'll feel faint, lose concentration and risk injury.
- you are more likely to fatigue early as muscle glycogen and blood sugar levels dip.
- you can't expect to exercise very hard or very long when you haven't fuelled your body for several hours.

❓ **How much to eat before training**

The exact amount you should eat depends on your body weight (heavier people need more) and how hard and long you plan to exercise (eat more for longer, harder workouts).

if you plan to work out for less than 2 hours, aim to eat around 1 g carbohydrate per kg of body weight (or 70 g for a 70 kg person) or 400–600 calories.

For longer workouts or endurance events eat around 2 g carbohydrate per kg of body weight (or 600–800 calories).

- **❓ When to eat before training**
- Ideally, you should aim to have a meal 2–4 hours before a workout. This should leave enough time to partially digest your food although, in practice, the exact timing of your pre-workout meal may depend on your daily schedule.
- Some literature recommended eating a moderately-high Carbohydrate, low fat meal 3 hours before exercise allows you to exercise longer and perform better.

- **❓ What are the best foods to eat just before a workout?**
- Slow-burning or low glycaemic index (GI) foods – that is foods that produce a gradual rise in blood sugar levels are the best foods before a workout.
- low-GI foods help spare muscle glycogen and avoid problems of low blood sugar levels during long training sessions.
- Low-GI meals may also help you burn more fat during exercise

☐ Why drink before training?

- It is important to ensure that you are properly hydrated before training to minimise the risk of dehydration during exercise.
- Exercise feels tougher when you are dehydrated and you cannot train as hard.

☐ When to drink before training?

- The best strategy is to keep hydrated throughout the day rather than load up with fluid just before your workout. Try to make a habit of drinking water regularly. Have a glass of water first thing in the morning and then schedule drinks during your day

Nutrition During Exercise

- Everyone exercising for longer than 30 minutes will certainly benefit from drinking something during exercise. But with the growing array of sports drinks, sports 'waters' and energy drinks it's a confusing choice for most regular exercisers.
- If you plan to exercise longer than 60 minutes, you may also benefit from additional carbohydrate.
- The amount of carbohydrate ingested is important for its contribution to energy expenditure and sparing of liver glycogen

The ideal nutritional strategy during exercise should:

- provide sufficient carbohydrate to maintain blood glucose levels and carbohydrate oxidation
- To provides a fuel source for the brain to maintain skills and decision making, and reduce the perception of fatigue.
- provide water and electrolytes to prevent fluid imbalance
- not cause any gastro-intestinal discomfort
- taste good.

Nutrition after Exercise

- The quicker you can begin refuelling after exercise, the quicker your body will recover.
- Any workout depletes your stores of glycogen – the readily available fuel stored in your muscles – and breaks down muscle tissue.
- Your aim is to rebuild these fuel stores and repair damaged muscle fibers as soon as possible.
- It is during this post-exercise period that your body gets stronger and fitter.

How much to drink?

Start drinking before you even get showered and changed.

The sooner you begin replacing the fluid you have lost through sweat, the sooner you will recover and cut the risk of post-workout dehydration. Fail to drink enough and you will feel listless with a risk of headache and nausea.

you need to drink 750 ml of water for every 0.5 kg of body weight lost during your workout. (1 kilogram of lost weight is equal to 1 litre of sweat, which needs to be replaced with 1.5 litres of fluid).

- **❓ What to drink?**
- If you have exercised for less than an hour, plain water is a good choice followed by a carbohydrate-rich snack within 2 hours.
- For longer or particularly intense workouts, a drink containing carbohydrate (sugar or maltodextrin) and sodium may further speed your recovery.
- carbohydrate at levels of approximately 6 g carbohydrate per 100 ml increases the speed of water absorption into the bloodstream.
- dry fruit juice diluted with an equal volume of water, diluted squash (1 part squash: 6 parts water)

When to eat or drink?

- Whether you are hungry or not, the quicker you consume food or drink after a workout, the quicker your body will recover.
- The enzymes that are responsible for making glycogen are most active immediately after your workout, leaving you a 2-hour window to reload your muscle glycogen.

How to Plan your Training Diet

- Use the Fitness Food Pyramid to devise your daily menu or to check your current eating plan. The foods in the lower layers of the pyramid should form the main part of your diet while those at the top should be eaten in smaller quantities.
- Include foods from each group in the pyramid each day.
- Make sure you include a variety of foods within each group.
- Aim to include the suggested number of portions from each food group each day.

Fitness Food Pyramid



UNIT FOUR

HEALTH RELATED COMPONENTS OF FITNESS AND PRINCIPLES OF EXERCISE PRESCRIPTION

By the end of this unit you should be able to:

- Identify the five components of health related physical fitness components
- Analyse health risks associated with excessively low body fatness
- Understand health risks associated with over fatness
- Appreciate and value the benefits of regular physical exercise to healthy living.
- Recognize the means and methods of developing the health related components of physical fitness

4.1. Health Related Components of Fitness

The overall goal of a total health related physical fitness program is to optimize the quality of life.

The specific goals of this type of fitness program are:

- To reduce the risk of disease,
- to improve total physical fitness so that, daily tasks can be completed with less effort and fatigue
- aimed at improving sport performance

A health related fitness program improves sport performance by increasing **muscular strength and endurance, improving flexibility and reducing the risk of injury.**

- Exercise scientists do not always agree on the basic components of physical fitness.
- However, most do agree that the five major components of total health-related physical fitness are: cardiorespiratory endurance, muscular strength, muscular endurance, flexibility and body composition

4.1.1. Cardiorespiratory Fitness

Meaning and Concepts of Cardiorespiratory Fitness

- Cardiorespiratory fitness: (sometimes called aerobic fitness or cardiorespiratory endurance) is considered to be a key component of health-related physical fitness.
- It is a measure of a heart's ability to pump oxygen-rich blood to the working muscles during exercise. It is also a measure of the muscle's ability to take up and use the delivered oxygen to produce the energy needed to continue exercising.

- In practical terms, cardiorespiratory endurance is the ability to perform endurance-type exercise such as (distance running, cycling, swimming, etc.).
- The individuals that have achieved a high measure of cardiorespiratory endurance are generally capable of performing 30 to 60 minutes of vigorous exercise without undo fatigue.

4.1.2. Muscle Fitness

Meaning and Concepts of Muscle Fitness

- There are two components of muscle fitness: strength and muscular endurance.
- Muscular strength: Is the maximal ability of a muscle to generate force. It is evaluated by how much force a muscle can generate during a single maximal contraction. Practically, this means how much weight that an individual can lift during one maximal effort.

- Muscular strength is important in almost all sports. Sports such as football, basketball, and events in track and field require a high level of muscular strength.
- Even non-athletes require some degree of muscular strength to function everyday life. For example, routine tasks around the home, such as lifting bags of groceries and moving furniture, require muscular strength.
- Weight training results in an increase in the size and strength of muscles.

- **Muscular Endurance:** Muscular endurance is defined as the ability of a muscle to generate force over and over again. Although muscular strength and muscular endurance are related they are not the same.
- These two terms can be best distinguished by examples. An excellent example of muscular strength is a person lifting a heavy barbell during one maximal muscular effort.
- In contrast, muscular endurance is illustrated by a weightlifter performing multiple lifts or repetition of a lightweight.

Muscle Structure and Contraction

- Muscle Structure: Skeletal muscle is a collection of long thin cells called fibers. These fibers are surrounded by a dense layer of connective tissue called fascia that holds the individual fibers together and separates muscle from surrounding tissues.
- Muscles are attached to bone by connective tissues known as tendons. Muscular contraction causes the tendons to pull on the bones, thereby causing movement.

- **Muscle Contraction:** Muscle contraction is regulated by signals coming from motor nerves. Motor nerves originate in the spinal cord and send nerve fibers to individual muscles throughout the body.
- The motor nerve and individual muscle fiber make contact at the neuromuscular junction (where the nerve and muscle fiber meet). Note that each motor nerve branches and then connects with numerous individual muscle fibers. The motor nerve and all of the muscle fibers it controls is called a motor unit.

Types of Muscle Contractions

- Muscle contractions are classified into two major categories: **isotonic and isometric**.
- **Isotonic** (also called dynamic) contractions: are those that result in movement of a body part.
- Most exercise or sports skills utilize isotonic contractions. For example, lifting a dumbbell involves movement of a body part and is therefore classified as an isotonic contraction.

- **An isometric** (also called static) contraction: requires the development of muscular tension but results in no movement of body parts. A classic example of an isometric contraction is, the individual exerting force against a wall of a building; the muscle is developing tension but the wall is not moving and therefore neither is the body part.
- Isometric contractions occur commonly in the postural muscles of the body during sitting or standing; for instance, they are responsible for holding the head upright.

- Note that isotonic contractions can be further subdivided into **concentric, eccentric, and isokinetic contractions.**
- **Concentric contractions** are isotonic muscle contractions that result in muscle shortening. The upward movement of the arm is an example of a concentric contraction.
- In contrast, **eccentric contractions** (Also called negative contractions) are defined as contractions in which the muscle exerts force while it lengthens.

- **Isokinetic Muscle Contractions** are concentric or eccentric contractions performed at a constant speed. That is, the speed of muscle shortening or lengthening is regulated at a fixed, controlled rate. A weight-lifting machine that controls the rate of muscle shortening generally accomplishes this.

Muscle Fiber Types

- There are three types of skeletal muscle fibers:
 - Slow twitch,
 - fast twitch, and
 - intermediate.
- These fiber types differ in their speeds of contraction and in fatigue resistance. Most human muscles contain a mixture of all three fibers types. Before beginning a strength-training program, it is helpful to have an understanding of each.

- **Slow-Twitch Fibers:** As the name implies slow-twitch fibers contract slowly and produce small amounts of force; however, these fibers are highly resistant to fatigue.
- Slow-twitch fibers, which are red in appearance, have the capacity to produce large quantities of ATP aerobically, making them ideally suited for a low-intensity prolonged exercise like walking or slow jogging.

- **Fast-Twitch Fibers:** Fast-twitch fibers contract rapidly and generate great amounts of force but fatigue quickly.
- These fibers are white and have a low aerobic capacity, but they are well equipped to produce ATP anaerobically.
- With their ability to shorten rapidly and produce large amounts of force, fast-twitch fibers are used during activities requiring rapid or forceful movement, such as jumping, sprinting, and weight lifting.

- **Intermediate Fibers:** Are although more red in color, possess a combination of the characteristics of fast- and slow-twitch fibers.
- They contract rapidly, produce great force, and are fatigue resistant due to a well-developed aerobic capacity.
- Intermediate fibers contract more quickly and produce more force than slow-twitch fibers but contract more slowly and produce less force than fast-twitch fibers

4.1.3. Flexibility

Meaning of Flexibility

- The body is flexible. It is supposed to be flexible. You must be able to bend and reach that something you dropped on the floor.
- Flexibility is the ability to move joints freely through their full range of motion. Without routine stretching muscles and tendons shorten and become tight, this can retard the range of motion around joints and impairer flexibility.
- Research suggests that flexibility is useful in preventing some types of muscle-tendon injuries and may be useful in reducing low back pain

Stretching Techniques

- Though there are a number of stretching techniques, three kinds of stretching techniques are commonly used to increase flexibility:

- ballistic,

- static, and

- proprioceptive neuromuscular facilitation.

Ballistic stretching promotes the stretch reflex and increases the risk of injury to muscles and tendons, only the static and proprioceptive neuromuscular facilitation methods are recommended.

Static Stretching

- Static stretching is extremely effective for improving flexibility and has gained popularity over the last decade. Static stretching slowly lengthens a muscle to a point at which further movement is limited (slight discomfort is felt) and requires holding this position for a fixed period of time.
- Compared with ballistic stretching, the risk of injury associated with static stretching is minimal.

- Proprioceptive Neuromuscular Facilitation
- It is a relatively new technique for improving flexibility. Proprioceptive neuromuscular facilitation (PNF) combines stretching with alternating contracting and relaxing of muscles. There are two common types of PNF stretching: contract-relax (C-R) stretching and contract-relax/antagonist contract (CRAC) stretching.
- The purpose of contracting the antagonist muscle is to promote a reflex relaxation of the muscle to be stretched.

4.1.4. Body composition

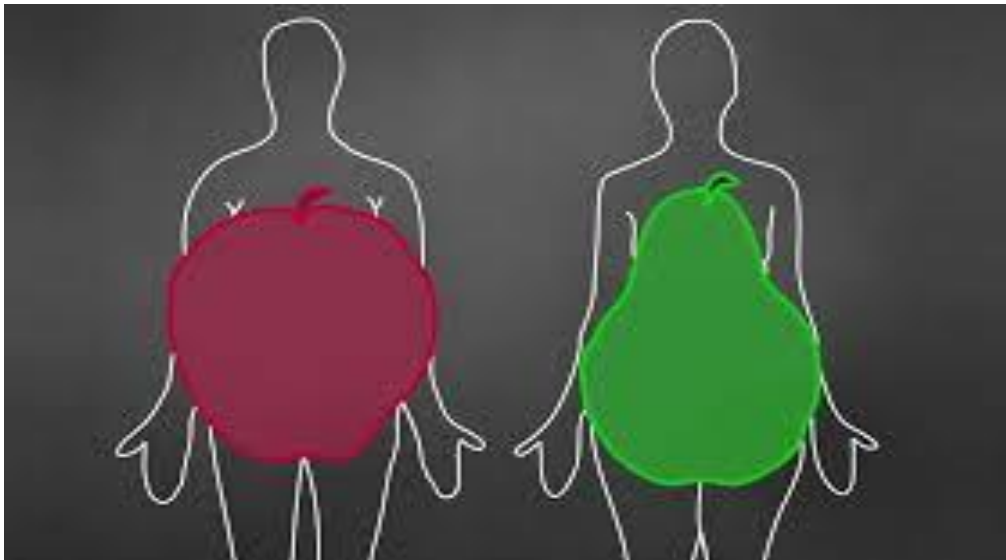
Meaning of Body Composition

- The term body composition refers to the relative amounts of fat and lean body tissue (muscle, organs, bone) found in your body.
- The rationale for including body composition as a component of health related physical fitness is that having a high percentage of body fat (a condition known as obesity) is associated with an increased risk of development of type 2 diabetes and contributes to joint stress during movement.

Health Risks Associated With Over Fatness

- Obesity has been elevated from a secondary to a primary risk factor for heart disease
- Physical fitness provides protection from the health risk of obesity
- Over fatness and obesity can contribute to degenerative disease, health problems, and even shortened life
- Heart disease is not the only disease that is associated with obesity

- Excessive abdominal fat and excessive fatness of the upper body can increase the risk of various diseases
- Apple shape/android fat / northern hemisphere for men and pear shape/southern hemisphere”/ gynoid for women



Health Risks Associated With Excessively Low Body Fatness

- Excessive desire to be thin or low in body weight can result in health problems
- Anorexia nervosa is the most severe eating disorder. If untreated, it is life threatening
- Bulimia is a common eating disorder characterized by bingeing and purging

How do people manage their body fat?

- The three most important factors to maintain a healthy body fat percentage are:
 1. Maintaining your lean muscle mass through routine strength training (minimum 2x/week for each muscle group)
 2. Maintaining a healthy well-balanced diet that is low in fat (<30% of calories from fat)
 3. Maintaining consistent sleep patterns (minimum 7 hours/night). Always seek the assistance of a medical or health and fitness professional for personal program guidance in reducing or managing your body fat.

4.2. Principles of Exercise Prescription for Health and Fitness

- Doctors often prescribe medications to treat certain diseases, and for every individual there is an appropriate dosage of medicine to cure an illness. Similarly, for each individual, there is a correct dosage of exercise to effectively promote physical fitness, called an exercise prescription.
- Exercise prescriptions should be tailored to meet the needs of the individual.
- It should include **fitness goals, mode of exercise, a warm-up, a primary conditioning period, and a cool-down**

4.2.1. Fitness Goals

- Establishing short-term and long-term fitness goals is an important part of an exercise prescription.
- Goals serve as motivation to start an exercise program. Further, attaining your fitness goals improves self-esteem and provides the incentive needed to make a lifetime commitment to regular exercise.
- A logical and common type of fitness goal is a performance goal. You can establish performance goals in each component of health-related physical fitness.

Establish Short-Term Goals First

Reaching short-term fitness goals is a great motivation to continue exercising. Therefore, establishment of realistic short-term goals is critical. After reaching a short-term goal, establish a new one.

Table 4.1 Fitness improvement goals

Fitness category	Current status	Short term goal	Long term goal
Cardiorespiratory fitness	Poor	Average	Excellent
Muscular strength	Poor	Average	Excellent
Muscular endurance	Very poor	Average	Good
Flexibility	Poor	Average	Good
Body composition	High fat	Moderately high	Optimal

Establish Lifetime Maintenance Goals

- In addition to short-term and long-term goals, consider establishing a fitness maintenance goal. A maintenance goal is established when your fitness goals have been met and your focus becomes remaining physically active and fit.

4.2.2. Mode of Exercise

- Every exercise prescription includes at least one mode of exercise that is, a specific type of exercise to be performed. For example, to improve cardio respiratory fitness, you could select from a wide variety of exercise modes, such **as running, swimming, or cycling.**
- Key factors to consider when selecting an exercise mode are enjoyment, availability of the activity, and risk of injury.
- Physical activities can be classified as being either **high impact or low impact** based on the amount of stress placed on joints during the activity

4.2.3. Warm-Up

- A warm-up is a brief (5- to 15-minute) period of exercise that precedes the workout. It generally involves light calisthenics or a low-intensity form of the actual mode of exercise and often includes stretching exercises as well.
- The purpose of a warm-up is to elevate muscle temperature and increase blood flow to those muscles that will be engaged in the workout. A warm-up can also reduce the strain on the heart imposed by rapidly engaging in heavy exercise and may reduce the risk of muscle and tendon injuries.

4.2.4. Primary Conditioning Period: The Workout Plan

- The major components of the exercise prescription that make up the primary conditioning period are the mode of exercise (described earlier), frequency, intensity, and duration
- ❖ The frequency of exercise is the number of times per week that you intend to exercise.
- ❖ The intensity of exercise is the amount of physiological stress or overload placed on the body during the exercise.
- ❖ the duration of exercise, the amount of time invested in performing the primary workout.

4.2.5. Cool-Down

The cool-down (sometimes called a warm-down) is a 5- to 15-minute period of low-intensity exercise that immediately follows the primary conditioning period.

- one primary purpose of a cool-down is to allow blood to be returned from the muscles back toward the heart.
- post-exercise muscle soreness may be reduced as a result of a cool-down.

4.4.1. Exercise Prescription for Cardio Respiratory Fitness

- Warm-Up
- Workout: Primary Conditioning Period

@Modes of exercise

@Frequency

@ Intensity

@ Duration

@ Intensity-Improvements in cardio respiratory fitness occur when the training intensity is approximately 50% of VO_2 max (this work rate is often called the training threshold).

Recall that training intensity can be monitored indirectly by measurement of heart rate.

The heart rate, which corresponds to exercise intensity sufficient to improve health-, related physical fitness is called the **target heart rate (THR)**. The most popular method of determining THR is the percentage of maximal heart rate (HR max) method.

This method works on the principles that exercise intensity (i.e., % VO₂ max) can be estimated by measurement of exercise heart rate.

To compute our THR using this method, simply multiply your HR max by both 90% and 70% to arrive at the high and low ends of your THR range.

For example, the maximal HR of a 20-year-old college student can be estimated by the following formula.

$$\text{HR max} = 220 - 20 = 200 \text{ beats/min}$$

The THR is then computed as $200 \text{ beats/min} \times 0.70 = 140 \text{ beats/min}$ and $200 \text{ beats/min} \times 0.90 = 180 \text{ beats/min}$

$$\text{THR} = 140 \text{ to } 180 \text{ beats/min}$$

In this example, the THR to be maintained during a workout to improve cardiorespiratory fitness is between 140 and 180 beats/min; this range of exercise intensities is sometimes called the **training sensitive zone**.

4.4.3. Training Techniques

- Endurance training is a generic term that refers to any mode of exercise aimed at improving cardio respiratory fitness.
- **1. Cross Training**

Cross training is a popular form of training that uses several different training modes. It may mean running on one day, swimming on another day, and cycling on another day.

One advantage of this type of training is that cross training reduces the boredom of performing the same kind of exercise day after day.

2. Long, Slow Distance Training

Long, slow distance training, or continuous training, requires a steady, sub maximal exercise intensity (i.e., the intensity is generally around 70% HR max). It is one of the most popular cardio respiratory training techniques and can be applied to any mode of exercise.

3. Interval Training

Interval training means undertaking repeated bouts or intervals of relatively intense exercise. The duration of the intervals can be varied, but a 1- to 5-minute duration is common. Each interval is followed by a rest period, which should be equal to, or slightly greater than, the interval duration.

4. Fartlek Training

Fartlek is a Swedish word meaning, "speed play," and it refers to a popular form of training for long-distance runners. Fartlek training is much like interval training, but it is not as rigid in its work-to-rest interval ratios.

An advantage of fartlek training is that these workouts provide variety and reduce the possibility of boredom.

The Concept of Progressive Resistance Exercise (PRE) is an application of the overload principle applied to strength and endurance exercise programs. Even though the two terms can be used interchangeably.

UNIT FIVE

ASSESSMENT OF FITNESS COMPONENTS

UNIT OBJECTIVES

By the end of this unit you should be able to:

- Understand the importance of fitness assessment prior to physical exercise program**
- Identify the different means to develop own physical fitness**
- Develop skill to assess one's own physical fitness**
- Interpret the results of fitness evaluation**

INTRODUCTION

- An objective evaluation of your current fitness status is important prior to beginning an exercise-training program.
- This evaluation provides valuable information concerning your fitness strengths and weaknesses and enables you to set reasonable fitness goals. Further, testing your initial fitness level also provides a benchmark against which you can compare future evaluations.

5.1. Evaluating Health Status

❑ Is a medical exam required before beginning a fitness program?

The answer is probably "no", for healthy college-age individuals. Although regular medical exams are encouraged for everyone, most people under 29 years of age generally do not require special medical clearance

❑ Should individuals over 30 years old have a medical exam at the beginning of an exercise program?

The most conservative answer is "yes." This is particularly true for obese and/or sedentary individuals. The following general guidelines apply:

5.2. **Assessment of Cardiorespiratory Fitness**

- Cardio respiratory fitness is the ability to perform endurance-type exercises (e.g., running, cycling, swimming, etc.) and is considered to be a key component of health-related physical fitness.
- The most accurate means of measuring cardio respiratory fitness is the laboratory assessment of maximal oxygen consumption called VO₂ max. In simple terms, VO₂ max is a measure of the endurance capacity of both the cardio respiratory system and exercising skeletal muscles

- 5.2.1. The 1.5-Mile Run Test
- One of the simplest and most accurate means of evaluating cardio respiratory fitness is the 1.5-mile run test.
- This test was popularized by Dr. Kenneth Cooper and works on the physiological principle that people with a high level of cardio respiratory fitness can run 1.5 miles in less time than less fit individuals. The 1.5-mile run test is excellent for physically active college-age individuals.

Table 5.1 Fitness Categories for Cooper's 1.5-Mile Run Test to Determine Cardio respiratory Fitness

Fitness category	Age category					
	13-19	20-29	30-39	40-49	50-59	60+
Men						
V. poor	>15:30	>16:00	>16:30	>17:30	>19:00	>20:00
Poor	12:11-15:30	14:01-16:00	14:46-16:30	15:36-17:30	17:01-19:00	19:01-20:00
Average	10:49-12:10	12:01-14:00	12:31-14:45	13:01-13:35	14:31-17:00	16:16-19:00
Good	9:41-10:48	10:46-12:00	11:01-12:30	11:31-13:00	12:31-14:30	14:00-16:18
Excellent	8:37-9:40	9:45-10:45	10:01-11:00	10:30-11:30	11:00-12:30	11:15-13:59
Superior	<8:37	<9:45	<10:00	<10:30	<11:00	<11:15
Women						
V. Poor	>18:30	>19:00	>19:30	>20:00	>20:30	>21:00
Poor	16:55-18:30	18:31-19:00	19:01-19:30	19:31-20:30	20:01-20:30	20:31-21:31
Average	14:31-16:54	15:55-18:30	16:31-19:00	17:31-19:30	19:01-20:00	19:31-20:30
Good	12:30-14:30	13:31-15:54	14:31-16:30	15:56-17:30	16:31-19:00	17:31-19:30
Excellent	11:50-12:29	12:30-13:30	13:00-14:00	13:45-15:55	14:30-16:30	16:30-17:30
Superior	<11:50	<12:30	<13:00	<13:45	<14:30	<16:30

5.2.2. The 1-Mile Walk Test

- Another field test to determine Cardio respiratory fitness is the 1-mile walk test, which is particularly useful for sedentary individuals.
- It is a weight-bearing test, however, so individuals with joint problems should not participate. The 1-mile walk test works on the same principle as the 1.5-mile run test. That is, individuals with high levels of Cardio respiratory fitness will complete a 1-mile walk in a shorter time than those who are less conditioned

Table 5.2 Fitness Classifications for 1-Mile Walk Test

Fitness category	Age category			
	13-19	20-29	30-39	40+
Men				
Very Poor	>17:30	>18:00	>19:00	> 21:30
Poor	16:01-17:30	16:31-18:00	17:31-19:00	18:31-21:36"
Average	14:01-16:00	14:31-16:30	15:31-17:30	16:01-18:30
Good	12:30-14:00	14:31-16:30	16:31-17:30	14:00-16:00
Excellent	<12:30	<13:00	<13:30	<14:00
Women				
V. poor	>18:01	>18:31	>19:31	>20:01
Poor	16:31-18:00	17:01-18:30	18:01-19:30	19:31-20:00
Average	14:31-16:30	15:01-17:00	16:01-18:00	18:00-19:00
Good	13:31-14:30	13:31-15:00	14:01-16:00	14:31-17:59
Excellent	<13:00	<13:30	<14:00	<14:30

5.2.3. The Cycle Ergo meter Fitness Test

For those with access to a cycle ergo meter (a stationary exercise bicycle that provides pedaling resistance via friction applied to the wheel), a cycle ergo meter fitness test is an excellent means of evaluating Cardio respiratory fitness.

5.2.4 The Step Test

An alternative test to determine your cardio respiratory fitness level is the step test. The step test works on the principle that individuals with a high level of cardio respiratory fitness will have a lower heart rate during recovery from 3 minutes of standardized exercise (bench stepping) than less conditioned individuals

After completing the test, sit quietly in a chair or on the step bench. Find your pulse and count your heart rate for 30-second periods during the following recovery 'times:

- ☐ 1.5 minutes post exercise
- ☐ 2- 2.5 minutes post exercise
- ☐ 3- 3.5 minutes post exercise

Table 5.3 Norms for cardio respiratory fitness using the Sum of three recovery heart rates obtained following the Step Test

Fitness Category	3-Minute step test recovery index	
	Women	Men
Superior	95-120	95-117
Excellent	121-135	118-132
Good	136-153	133-147
Average	154-174	148-165
Poor	175-204	166-192
V. poor	205-233	193-217

5.3 Assessment of Muscle Fitness

5.3.1 Assessing Muscular Strength

As discussed in unit 4, muscular strength is defined as the maximum amount of force you can produce during one contraction. Muscular strength not only is important for success in athletics, but also is useful for the average person in performing routine tasks at work or home.

Strength can be measured by the one-repetition maximum (1 RM) test, which measures the maximum amount of weight that can be lifted one time.

$$\text{Muscle strength score} = \frac{\text{1RM weight}}{\text{Body weight}} \times 100$$

$$\begin{aligned} \text{Therefore, muscle strength score} &= \frac{180 \text{ pounds}}{150 \text{ pounds}} \times 100 \\ &= 120 \end{aligned}$$

Using the table below, a muscle strength score of 120 on the bench press places a college age man in the “good” category.

Table 5.4 Fitness category of muscle strength score

Exercise	V. Poor	Poor	Average	Good	Excellent	Superior
Men						
Bench press	<50	50-99	100-110	111-130	131-149	>149
Biceps curl	<30	30-40	41-54	55-60	61-79	>79
Shoulder press	<40	41-50	51-67	68-80	81-110	>110
Leg press	<160	161-199	200-209	210-229	230-239	>239
Women						
Bench press	<40	41-69	70-74	75-80	81-99	>99
Biceps curl	<15	15-34	35-39	40-45	56-59	>59
Shoulder press	<20	20-46	47-54	55-59	60-79	>79
Leg press	<100	100-130	131-144	145-174	175-189	>189

5.3.2 Assessing Muscular Endurance

Muscular endurance is the ability of a muscle or muscle group to generate force over and over again.

A. The Push-Up Test

Table 5.5 Fitness category based on push-ups (1 min)

Men	Age: 20-29	Age: 30-39	Age: 40-49	Age: 50-59	Age: 60+
Excellent	54 or more	44 or more	39 or more	34 or more	29 or more
Good	45-54	35-44	30-39	25-34	20-29
Average	35-44	24-34	20-29	15-24	10-19
Poor	20-34	15-24	12-19	8-14	5-9
Very poor	20 or fewer	15 or fewer	12 or fewer	8 or fewer	5 or fewer
Women	Age 20-29	Age 30-39	Age 40-49	Age 50-59	Age:60+
Excellent	48 or more	39 or more	34 or more	29 or more	19 or more
Good	34-48	25-39	20-34	15-29	5-19
Average	17-33	12-24	8-19	6-14	3-4
Poor	6-16	4-11	3-7	2-5	1-2
Very poor	6 or fewer	4 or fewer	3 or fewer	2 or fewer	1. or fewer

B. The Sit-Up Test

The bent-knee sit-up test is probably the best field test available to evaluate abdominal muscle endurance.

Table 5.6 Fitness category based on sit-ups (1 min)

Age group (years)	Fitness category					
	V. poor	Poor	Average	Good	Excellent	Superior
Men						
17-29	<17	17-35	36-41	42-47	48-50	>50
30-39	<13	13-26	27-32	33-38	39-48	>48
40-49	<12	12-22	23-27	28-33	34-43	>43
50-59	<8	8-16	17-21	22-28	29-38	>38
60+	<6	6-12	13-17	18-24	25-35	>35
Women						
20-29	<14	14-18	29-32	33-35	36-47	>47
30-39	<11	11-22	23-28	29-34	35-45	>45
40-49	<9	9-18	19-23	24-30	31-40	>40
50-59	<6	6-12	13-17	18-24	25-35	>35
60+	<5	5-10	11-14	15-20	21-30	>30

5.4 Assessment of Flexibility

Flexibility is the ability to move joints freely through their full range of motion. Flexibility can decrease over time due to tightening of muscles and/or tendons. The key to maintaining flexibility is a program of regular stretching exercises.

5.4.1 Trunk Flexibility

The sit and reach test measures the ability to flex the trunk, which means stretching the lower back muscles and the muscles in the back of the thigh (hamstrings).

Table 5.7 Physical fitness norms for trunk flexion using the sit and reach test.

Sit and reach score	Fitness classification
-6 to -15	Very poor
-1 to -5	Poor
0 to +1	Average
+2 to +3	Good
+3 to +5	Excellent
+6 or above	Superior

5.4.2 Shoulder Flexibility

- As the name implies, the shoulder flexibility test evaluates shoulder range of motion (flexibility). The test is performed in the following manner.
- Table 5.8 Physical Fitness Norms for Shoulder Flexibility:

Right Hand Up Score	Left Hand Up Score	Fitness Classification
<0	<0	Very poor
0	0	Poor
1	+1	Average
+2	+2	Good
+3	+3	Excellent
+4	+4	Superior

5.5 Assessment of Body Composition

- Every person should possess at least a minimal amount of fat (percent body fat) for a good health.
- This fat is called essential fat and is necessary for temperature regulation, shock absorption and regulation of essential body nutrients, including vitamins A, D, E and K.
- The exact amount of body fat considered essential to normal body functioning has been debated.

5.5.1. The Skin Fold Test

Subcutaneous fat is measured using an instrument called a skin fold caliper. The skin fold test relies on the fact that over 50% of body fat lies just beneath the skin.

Therefore, measurement of representative samples of subcutaneous fat provides a means of estimating overall body fatness. Skin fold measurement to determine body fat is reliable but generally has a $\pm 3\%$ to 4% margin of error.

- One of the most accurate skin fold tests to estimate body fatness requires three skin fold measurements for both men and women.
- The anatomical sites to be measured in men (chest, triceps, and sub scapular skin folds) and the measurement sites for women (triceps, suprailium, and abdominal skin folds).
- Note that for standardization, all measurements should be made on the right side of the body.

Table 5.11 Body Composition fitness categories for men and women

Percent Body Fat	Body Composition Fitness Category
Men	
<10%	Low body fat
10-20%	Optimal range of body fat
21-25%	Moderately high body fat
26-31%	High body fat
>31%	Very high body fat
WOMEN	
<15%	Low body fat
15-25%	Optimal range of body fat
26-30%	Moderately high body Fat
31-35%	High body fat
>35%'	Very high body fat

5.5.2. Estimation of Body Composition: Field Techniques

Several quick and inexpensive field techniques exist to evaluate body composition and the risk of heart disease associated with over-fatness. Here we describe some of the more popular procedures currently in use.

A. Waist-to-Hip Circumference Ratio: recent evidence suggests that, the waist-to-hip circumference ratio is an excellent index for determining the risk of disease associated with high body fat.

Table 5.12 Waist –to –hip circumference ratio rating scale Classification.

Risk of disease	Men	Women
High risk	>1.0	>0.85
Moderately high risk	0.90-1.0	0.80-0.85
Optimal low risk of disease	<0.90	<0.80

- B. Body Mass Index: Although many limitations exist, research has shown that the body mass index (BMI) is a useful technique for placing people into categories of normal or too much body fat.
- C. The BMI is simply the ratio of the body weight (kilograms; kg) divided by the height (in meters) squared (m²): $BMI = \text{weight (kg)} / \text{height (m)}^2$
- (Note: 1 kg = 2.2 pounds and 1 m = 39.25 inches.)
- For example, if an individual weighs 64.5 kg and is 1.72 m tall, the BMI would be computed as follows:
- $$64.5 \text{ kg} / (1.72 \text{ m})^2 = 64.5 / 2.96 = 21.8$$

Table 5.13 Body Mass Index Classification of the Degree of Body Fatness.

Degree of obesity	BMI	
	Men	Women
Optimal body fat	<25	<27
Moderately high body fat	25 – 30	27 – 30
High body fat	31 – 40	31 – 40
Very high body fat	>40	>40

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