

## HEALTH AND PHYSICAL EDUCATION

### CLASS XII

#### UNIT – 2

#### SCIENTIFIC BASIS OF HUMAN MOVEMENT

#### EFFECTS OF EXERCISE ON RESPIRATORY SYSTEM

Exercise or any physical activity has a special effect on respiratory system . We need oxygen at rest and during exercise , since energy supply to the active muscles increases demand of oxygen . Another important function of respiration is to eliminate carbon dioxide from the body. During exercise cellular oxidation increases and thereby carbon dioxide production increases. Respiratory system maintain an efficient balance between the oxygen and carbon dioxide in the blood at rest and also during exercise. There are some immediate changes that occur during exercise programme. Also , there are some relatively permanent changes following long-term physical training , the magnitude of changes being dependent on type , intensity and duration of exercise.

Immediate changes during exercise :

- a) Tidal Volume : The amount of air which we inhale or exhale during quiet breathing is called tidal volume. It is around 500 ml. During exercise , this tidal volume increases. Depending on intensity it may be 1500-2000 ml for ordinary person and for well trained athlete it may be increased to 2500 ml.
- b) Respiratory rate : Number of times one takes inspiration or expiration in each minute is called Respiratory rate. At rest , respiratory rate is around 16 per minute. During exercise , for ordinary persons it may be increased to 25-30 per minute and for well trained athlete it may be around 38-40 per minute.
- c) Pulmonary Ventilation : The amount of air which passes through lungs is each minute is called Pulmonary ventilation . The Pulmonary ventilation (PV) = Tidal volume (TV) X Respiratory rate (RR) and therefore at rest it is around 8 lit / min . During exercise since both TV and RR increases , PV will also increase depending on the intensity of exercise . For ordinary person , the value of PV may be 40-50 lit / min and for well trained athlete , it may be around 100 lit / min .
- d) Oxygen uptake : The amount of oxygen which we take inside the body from ambient air in each minute at rest is called resting oxygen uptake. It is around 200-300 ml / min . During exercise oxygen uptake increases to 3.5 lit / min for ordinary person and 4.5 lit/min for well trained athlete.
- e) Lung diffusion capacity : Diffusion is the process of movement of gas molecules ( O<sub>2</sub> and CO<sub>2</sub> ) that takes place in the lungs and tissues. During exercise there will be more movement of gas molecules and diffusion capacity increases.
- f) Lung volume : For normal breathing at rest lung expand and there is a change in air pressure . During exercise due to rapid movement of diaphragm and intercostal muscles total area of lung expands to accommodate more exchange of gases.

#### Long-term effect of training on Respiratory system

- a) Tidal Volume (TV) : Trained athlete's capacity to inhale or exhale air during exercise increases to the tune of 2500 ml. Untrained persons can not increase up to this level because their capacity is less than trained athletes.

- b) Respiratory rate (RR) : Trained athlete may increase their rate to 40 in each minute from 16 / min at rest. Untrained persons will not be able to reach to this level . They may increase their rate up to 25-28 / min.
- c) Pulmonary ventilation (PV) : A trained athlete may increase PV to around 100 lit/min . This is because their TV and RR both increases during exercise. Untrained persons may increase it up to 50-60 lit/min.
- d) Oxygen uptake : During exercise , after a long term training , a trained athlete may consume around 5 lit oxygen per minute. Untrained persons may go up to the level of 3.5 lit oxygen per minute.
- e) Lung diffusion capacity : During exercise , the lung diffusion capacity increases in both trained and untrained persons . However, trained athletes may increase their diffusion capacity 30% more than that of an untrained person because athlete's lung surface area and red blood cell count is higher than that of the non-athletes.
- f) Vital capacity : It is the maximum volume of air forcefully expired after a maximal inspiration. For a healthy adult male it is around 4.8 lit and for women 3.1 lit. The athletes who are under training for a long period may increase vital capacity to around 6 lit.
- g) Efficiency of lung : An athlete's total efficiency of the lung remain at higher level than the non-athletes. This efficiency is the key factor for higher rate of oxygen uptake than non-athletes.
- h) Second wind : This term is usually described as a sudden transition from an ill-defined feeling of distress or fatigue during the early portions of prolonged exercise to a more comfortable , less stressful feeling later in exercise. It has been observed that trained athletes get their second wind comfortably and easily than non-athletes.

### Hypo kinetic Diseases

With the invention of antibiotic , infectious diseases are now controlled to a large extent. There are many persons who maintain their good health even when they are 80+ . With the technological advancement, better nutrition and health care management life of many persons are relatively easy and smooth. But human being has invited some problems for itself and change of life style is responsible for such problems. Health scientists have identified few diseases that are related to inactive life style and these are colon cancer, all sorts of heart diseases, Diabetes (type-II) and rheumatic arthritis. Sedentary life style, no physical labour in daily routine and lack of physical fitness are mainly responsible for hypo kinetic diseases.

### Obesity, weight control and active lifestyle.

Technological revolution has created a world where physical labour has been replaced by various gadgets and machine. Automobiles, cheap public transport and handy tools have restricted our basic movement like walking and other physical labour which were essential part of daily livings, even fifty years before.

The term 'Obesity' is associated with another term overweight. Overweight refers to excessive body weight in relation to the height , body build and sex. An overweight person ( athlete , body builder , power lifter etc ) is not necessarily always obese. For 'obesity' we will have to consider body composition , particularly body fat percentage and body mass index ( BMI ). Excess weight is a burden physically , socially , economically and psychologically . When excess weight is associated with higher percentage of body fat , it is obesity . Excessive accumulation of fat beyond the considerable limit for that age , sex and body type is referred to as 'obesity' Obesity

is a case of human containing body fat above considerable limit , not just overweight. Obesity is defined as more than 25% fat for men and more than 33% fat for women and is associated with a variety of health problems . Pre-mature death rate is higher among obese people than it is among normal body weight and composition. The overweight and obese have a higher incidence of atherosclerosis and other coronary heart diseases , hypertension , diabetes , kidney and liver diseases , gout etc. For maintenance of ideal body weight and fat% , it requires a balance between food intake (calorie) and physical activity / sports and games participation as channel of energy expenditure. If you take more than required calorie ( from food ) as per your age and sex , and do not burn out energy through physical activity , the extra calorie will finally accumulate as fat in the body. It is better to prevent obesity from occurring rather than treating it . Evidence indicates that the seeds of obesity are planted very early in life , so early , in fact that the affected individual has little say or control in the matter. Parental actions during this time may significantly influence the child's future weight problems . early overfeeding may lead to the proliferation of fat cells . This is probably irreversible and will adversely affect efforts to control body weight during adulthood.

Measurement of body fat% consists of complicated method . Scientists have developed some technique for estimation of body fat% . One of such methods is skin fold measurement. Skin fold calliper is used to measure skin fold thickness of chest , abdomen and thigh for male and triceps , sacroiliac and thigh for female . Sum of the three skin fold is then placed in a table calibrated as per age and sex and percentage of fat is estimated . Another technique is girth measurement . With a cloth tape , circumference of right upper arm , abdomen and right forearm for male of 18-26 years and abdomen , right thigh and right forearm of female of 18-26 years are measured . These circumference measurements are placed in a calibrated table and %fat is predicted. Body Mass Index (BMI) measurement is relatively easy. Only height ( in metres ) and body weight ( in kg ) are to be measured . Then BMI is calculated from the formula developed by health scientists .

$$\text{BMI} = (\text{Body weight}) / (\text{Body height})^2$$

Classification of overweight and obesity by BMI :

Normal -----	BMI kg/m <sup>2</sup> -----	18.5 to 24.9
Overweight-----		25 to 29.3
Obese ( Type I ) -----		30 to 34.9
Obese ( Type II ) -----		35 to 39.3
Extreme Obese -----		40 and above

Maintaining ideal body weight as per height is important for all. Following table is the desirable weight ranges for adults :

Height ( cm )	Weight ( kg )	
	Men	Women
147		42-54
152		44-57
158	51-64	46-59
163	54-67	49-63
168	56-71	52-66
173	60-75	55-70
178	64-79	59-74

The weight ranges against height is given because most people have different body types. This chart is only a guideline and may be different for younger population ( 19-34 years ) than older ( 35+ years ) people. For ready reference one may use Broka's Index. This index is determined by the formula ;

Ideal body weight (kg) = Height in cm  $\div$  100

Cause of Obesity :

- i) Genetic factor : Genetic make up does not necessarily cause obesity , but it contributes significantly to differences in weight gain for individuals fed an identical daily calorie excess. Genetic factors determined about 25% of the transmissible variation among people in percent body fat and fat mass.
- ii) Physical Activity : Amount of physical activity is an important factor of energy expenditure. If calorie intake is not balanced with physical activity , small quantity of excess calorie will be accumulated as fat. From young age boys and girls be advised to learn the relationship between physical activity and body fat ; more the exercise , less the body fat.
- iii) Fat cell size and number : The size and number of fat cells provide a view of the structure form and dimensions of normal and abnormal levels of body fat. Increase in adipose tissue mass occurs in two ways ; a) enlargement of existing fat cells with more fat and b) increase in the total number of fat cells.
- iv) Right eating habits : Food is essential for energy production , heat production and maintenance of body tissues. Food intake should be limited and at par with physical activity level , age and sex. Ratio of carbohydrate , fat and protein should be 4:1:1. Restriction should be made on sweets , fatty and oily stuff.
- v) Hormonal disorder : Due to hormonal disorder of thyroid gland and pituitary , excessive fat ma accumulate .
- vi) Age factor : After 40-45 years of life , general trend is to lead a sedentary life style. If calorie intake is not restricted and physical activity is neglected , every possibility is there to accumulate more fat. This may be a hazard in later life.

Further economic solvency , irregular life style and bad habits including habitual alcoholic may lead to obesity. It requires a balance between calorie intake and physical activity and conscious planning is necessary to avoid obesity.

Effect of obesity : Obesity is associated with variety of health problems and these are :

- Premature death
- Cardiovascular diseases
- Hypertension
- Diabetes
- Kidney diseases
- Gall bladder problems
- Liver dysfunction
- Cancer of selected body parts
- Arthritis
- Gout
- Back pain
- Reproductive disorder in women
- Dyspnoea

- Sleep disorders and snoring

#### Diet for Obese persons :

General principles of diet for general people will remain same but obese persons should avoid following items from their diet:

- Sweets , Chocolates , jam cake etc
- Tuber and root type vegetables
- All sorts of fried foods
- Nuts and dried fruits
- Cream and fats like ghee, butter etc
- All fast foods and canned preserved foods
- Alcohol
- Mango, Dates , Banana and similar sweet fruits

Principles of weight loss for the obese :

- Plan your diet and exercise programmes
- Plan for 6 to 8 weeks to see the result
- Calorie restriction in the diet should not be more than 500 calorie per day
- Begin exercise for 3 days in a week , 45-60 mins per day
- Gradually exercise for 5 days and 90 mins per day
- Eating habits should be changed . If you eat 4 times a day , make it thrice a day and no snacks should be included in the meals .

#### Role of Exercise to prevent obesity :

Exercise will provide lasting benefits if it is programmed as an integral part of one's life style. Regular exercise will fetch following benefits for obese people:

- Improve physical fitness in general
- A better co-ordination among the organs and systems of the body.
- If intensity , duration and frequency of exercise is increased gradually , it can burn out extra fat deposits in various body parts .
- Depending on nature of exercise , strength , endurance and cardio-respiratory fitness will improve.
- Reduces the risk of cardio-vascular disease
- Helps control diabetes
- Develops stronger bones that are less susceptible to injury
- Acts as a stimulus for other life style changes
- Improves body image and self esteem

#### Classification according to nature of Physical labour / activity

Calorie intake from food and calorie expenditure in terms of body maintenance and physical activity are the two sides of the same coin. We get energy from food stuff and we utilise that energy during all sorts of movement , physical activity , house-hold work , play and recreation . There shall be a balance between energy intake and expenditure . If energy intake is more than the expenditure then energy balance will be a positive one. Excess calorie will convert into fat and will accumulate. If energy intake of a person is 500 calorie more than his quota of energy expenditure , then after seven days he will have 3500 calorie excess which is equivalent to around 500 gm of fat. On the other hand , if the energy intake is relatively less than the energy expenditure , then accumulated fat will be utilised to make a balance between energy in and out. This is referred to as negative energy balance and body weight is lost.

On the basis of energy expenditure , nature of physical activity , age and sex human beings are classified into three categories :

Work category

Energy expenditure/day(calorie)

	Men	Women
Light working	2200-2500	1800-2300
Moderate working	2800-3500	2500-2800
Heavy working	4000-5000	3000-3800

#### Balanced diet and distribution of calorie intake

Nutrition scientists have identified four basic food groups and in a balanced diet food stuff from all these four groups should be included :

- 1) Cereals and whole grain food : This group will have maximum quota. It means proportionally higher amount in the diet than other groups.
- 2) Vegetables and fruit groups : In the diet sufficient vegetables including leafy vegetables should be included and their proportion is next to cereals . Fruits are equally important and should cover a sizable portion in the diet , almost near the consumption of vegetables.
- 3) Meat & poultry group : This group consists of protein substances - fish , meat , chicken , beans , nuts etc and quantity of such stuff is limited , less in comparison to group 1 and 2.
- 4) Milk and milk products : This group should be almost equal to that of meat group. Requirement is essential but intake should be limited.

Over and above , fats , oils and sweets should be very very meagre in the diet.

The calorie available from these major energy providing sources are as follows:

Food category	Amount ( gm )	Kcal available	% Total daily calorie requirement
Protein	80-110	324-350	12-13
Fat	100-110	1025-1050	38-40
Carbohydrate	250-275	1080-1200	40-45

Total daily requirement for light working men is 2500-2800 calorie and for women is 2000-2200 calorie.

For heavy working people , distribution should be as follows :

Protein	140-185	700-750	14-15
Fat	160-170	1450-1500	29-30
Carbohydrate	650-680	2750-2800	55-56

A suggested daily diet chart is given below. Actual amount should be planned as per calorie requirement considering age, sex and nature of physical activity.

Food Item	Amount(gm) per day
Cereals	200
Millet/whole grains	200
Pulses	100
Leafy vegetables	115
Other vegetables	85
Fruits	80
Milk/milk products	200
Fish/Meat	50
Egg	30
Vegetable oil,ghee,butter	40
Sugar	45

#### Steps for fat reduction :

- 1) Regular participation in physical activity
- 2) Try to exhaust yourself through running or jogging , this will burn out fat.
- 3) Plan your diet . Have a slight negative calorie balance in each day.
- 4) Have a mind set to reduce body fat in a specified time.

- 5) Maintain calorie output through exercise and decrease calorie intake.
- 6) maintain calorie intake , increase calorie output.
- 7) consciously eliminate fat and sweets from diet as far as possible.
- 8) have an active life style.

Exercises for prevention of obesity:

- 1) Aerobic activities are the best , for e.g, walking , jogging , cycling , swimming , rowing , aerobic dance etc
- 2) Court games such as handball , badminton , etc
- 3) weight training and callisthenics
- 4) Free hand exercises like sit ups , Jumping Jack , Leg side kinking , etc
- 5) Yoga have some influence to develop flexibility but for fat reduction , it has limited scope.

Hypertension

Hypertension is high arterial blood pressure . It is a major health hazard . when arterial systolic blood pressure is 140 mm Hg or more or a diastolic pressure is of 90 mm Hg or greater , it is referred to as Hypertension. In people between 40 and 60 years , blood pressure above 150/90 mm Hg increases the risk of heart disease by three times in men and by six times in women.

Blood Pressure is the lateral pressure exerted by the blood on the vessel wall. It is expressed in mm of mercury ( mm Hg ) . For e.g , a blood pressure of 120 mm Hg is equal to the pressure exerted by a column of mercury 120 mm Hg.

Systolic Blood Pressure is the maximum pressure during systole ( contracting phase ) and the average value is 120 mm Hg for healthy adults. Generally , systolic pressure between 110-130 mm Hg is considered as normal. Diastolic blood Pressure is the minimum pressure during diastole ( relaxation / ventricular filling phase ) and the average value is 80 mm Hg for healthy adults . Generally , diastolic pressure between 70-90 mm Hg is considered as normal. Pulse pressure is the difference between the systolic and diastolic pressure. If systolic pressure is 120 and diastolic pressure is 80 mm Hg , then pulse pressure shall be 40 mm Hg . It is felt as a throbbing pulsation in an artery during systole. Mean Arterial pressure is the pressure that propels the blood to the tissues. MAP is not simply the value halfway between systolic and diastolic pressure . Instead , it is roughly equal to the diastolic pressure plus one-third of the pulse pressure. High blood pressure or Hypertension is a casual agent in stroke , congestive heart failure , kidney failure and heart attack. Hypertension is classified as primary or secondary and categorised by severity. The causes of primary hypertension which accounts for 95% of cases , are unknown. The causes for secondary hypertension are endocrine or structural disorder. Symptoms of hypertension include headache , heart failure , renal failure , neurological problems and chest pain. However , during the early stages of hypertension there are usually no symptoms and for this reason hypertension is sometimes called the "Silent killer" .

Measurement of Blood Pressure

Sphygmomanometer is the instrument by which arterial blood pressure is measured. Stethoscope is also used to listen to the sound created by the flow of blood. The instrument consist of a double layer rubber band connected to a mercury column in one side and to a hand rubber on the other hand. Rubber band is wrapped around the arm just over the elbow and inflated by using the hand pump until the cuff pressure exceeds systolic pressure. At this point , blood flow into the arm is topped and a bronchial pulse can not be felt or heard. As the cuff pressure is gradually reduced by unscrewing the knob of the pump , the examiner listens with a stethoscope for sound in the bronchial artery . The pressure read from the mercury column , as the first soft

tapping sounds are heard. i.e, the first point at which a small amount of blood is spurting through the constricted artery , and is systolic pressure. As the cuff pressure is reduced further , these sounds become louder and more distinct , but when the artery is no longer constricted and blood flows freely , the sounds can no longer be heard. The pressure at which the sounds disappear is the diastolic pressure.

#### Causes of Hypertension

About 90% of hypertensive people have primary hypertension , in which no underlying cause has been identified. However , the following factors are believed to be involved :

- 1) Diet : Dietary factors that contribute to hypertension include high sodium , saturated fat and cholesterol intake.
- 2) Obesity : Excessive body fat may invite hypertension.
- 3) Age : Clinical signs of the disease usually appear after 40 years of age.
- 4) Race : More blacks than whites are hypertensive among American population.
- 5) Heredity : Hypertension runs in families. Children to hypertensive parents are more likely to develop hypertension.
- 6) Stress : Those who are suffering from stress in their life are susceptible to hypertension.
- 7) Smoking : Nicotine has a profound vasoconstrictor effect , which may result in hypertension among smokers.

#### Steps to be followed to avoid Hypertension

- Control your body weight and reduce body fat.
- Plan your diet. Avoid fatty substances and hard sweets as far as possible and right from early age.
- No Smoking
- Restrict tea , coffee , alcohol and beverages .
- Those having family history of hypertension should check blood pressure regularly and seek medical advice. If required , regular medication may be necessary.
- Regular exercising is a good practice.

#### **Diabetes Mellitus ( DM )**

Chronic high blood glucose level or hyperglycaemia is the hall mark of the disease Diabetes Mellitus. The name of this is derived from the fact that glucose ÷spills over ÷ into the urine when the blood glucose concentration is too high. High blood glucose level of DM results from either the insufficient secretion of insulin by the beta cells of islets of langerhans of pancreas or the inability of secreted insulin to stimulate the cellular uptake of glucose from the blood. When insulin is absent or deficient , blood sugar levels remain high after a meal because glucose is unable to enter most tissue cells. There are two forms of DM . Type I or insulin-dependent diabetes , when beta cells are destroyed and secrete little or no insulin . This form of the disease accounts for only about 10% of the cases of diabetes in our country. About 90% of the people who have diabetes have Type II or non-insulin-dependent DM. Type I diabetes is also called juvenile-onset diabetes , because this condition is usually diagnosed in people under the age of thirty . Type II or maturity-onset diabetes is usually diagnosed in people over the age of thirty .

The three cardinal signs of diabetes mellitus are

- i) polyuria , a huge urine output that leads to decreased blood volume and dehydration.
- ii) polydipsia ó excessive thirst
- iii) polyphagia , refers to excessive hunger and food consumption.

Type I DM results when the beta cells of the islets of langerhans are destroyed by the effect of a virus or other environmental agent. Removal of the insulin-secreting cells in the way causes hyperglycaemia or high blood sugar and the appearance of glucose in the urine. The lack of insulin contributes to the release of large amount of fatty acids into the blood. In Type II DM , the body is still producing insulin but it is either not enough or not released quickly enough after eating to process all the glucose. Often, enough insulin is released but the insulin receptor cells do not react to it in the normal way . This condition is known as insulin resistance. There is a chance to develop Type II DM if you are over-weight and obese , as obese people need to produce proportionally more insulin to manage their blood glucose and extra body fat leads to increased insulin resistance. If a member of family is suffering from DM , others in the family are at risk to develop Type II DM after 40 years of age . One of the biggest dangers of untreated diabetes is heart disease. Besides controlling blood sugar , insulin's other function is to help to store fat. If there is not enough insulin to do this , or the cells are insulin resistant , the fat cells remain in the blood stream , leading to higher levels of blood cholesterol. This may lead to raise blood pressure and impairing the flow o blood through the arteries. If you suspect , you may have DM , the best thing is to check the blood sugar level. The test is relatively simple. Only a few drops of blood is taken from finger and by a glucometer , glucose level is measured . Normal blood sugar level of an adult is around 120mg% , varying by 10mg% on both sides. Generally , blood sugar level above 140mg% is considered as diabetic. When blood sugar level cross 180mg% , it appears in the urine , which may be confirmed by urine test for glucose.

#### Control of DM

DM is a metabolic disorder and therefore one can control the disease to a large extent. Control of all types of diabetes involves maintaining normal or near normal blood glucose level, through appropriate therapy. The appropriate therapy depends on the type of diabetes being treated and may include insulin , oral hypo-glucomic agents, diet and exercise. Following are few guidelines :

1. Consult physician and check blood sugar at a regular interval.
2. Eliminate extra fat and sweets from the diet . Have planned diet as per your age , sex and physical activity level.
3. Body weight should be controlled. Check BMI and body weight regularly.
4. Participate in regular physical exercise and sports. Walking , swimming , Jogging , cycling , weight training , court games are good form of physical exercise.
5. Person with very high blood sugar must take medical advice before participation in physical exercise.

#### Diabetes insipidus

This is a disease associated with the inadequate secretion or action of ADH ( Anti-diuretic hormone ) released from posterior part of pituitary. Diabets insipidus is a syndrome marked by the output of huge amount of urine and intense thirst. Symptom is this disease include polyuria , polydipsia and severe ionic imbalance . Diabetes insipidus distinguishes itself from diabetes mellitus in which insulin deficiency causes large amount of blood sugar to be lost in the urine.

Diabetes insipidus can be caused by a blow to the head that damages the hypothalamus or the posterior pituitary. In either case, ADH release is deficient. Though inconvenient , the condition is not serious when the thirst centre is operating properly and the person drinks enough water to prevent dehydration. Diabetes insipidus is treated by indaction of ADH.