
UNIT 9 NUTRITIONAL CARE IN WEIGHT MANAGEMENT

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9.1 INTRODUCTION

Weight management has assumed a lot of significance in the present scenario with increasing affluence, abundance of convenience foods and lack of physical activity. There is nothing mysterious about what causes people to be overweight. Excess weight is the result of long term, consistent consumption of much more calories than you are able to expend, irrespective of the etiology. The emphasis in treating obesity currently has shifted from mere 'weight loss' to 'weight management' which implies that efforts should be directed towards attaining the best possible weight (desirable body weight) in relation to overall health.

We have already learnt in the previous unit that obesity is one of the important factors in the causation of certain types of cancers and many other diseases like arthritis and cardiovascular disease. In this unit you will come across the significance of maintaining appropriate weight for preventing certain other types of chronic degenerative diseases. We will also learn about the various approaches the overweight, the obese and the morbidly obese individuals need to consider for attaining desirable weight and more importantly, how you can prevent putting on weight in the first place.

Too much deviation on either side from the appropriate range of body weight increases our risk of health problems. Just as overweight as the result of positive energy balance, underweight results when the energy balance is negative. Obsession with slimming, especially in the adolescent age group may result in eating disorders like anorexia nervosa and bulimia nervosa. How to cope with problems of underweight? This is the focus of the second part of the unit.

Objectives

After studying this unit, you will be able to:

- explain the importance of maintaining a desirable weight throughout the life,
- enumerate the guidelines for calculating the ideal body weight, and
- describe the causative factors, prevention and treatment of various conditions related to weight management (such as obesity, underweight).

9.2 WEIGHT IMBALANCE – PREVALENCE AND CLASSIFICATION

You are aware that obesity is one of the major public health problems of the world. Earlier a problem of the developed nations, it is now increasingly afflicting our country. Maintenance of a fairly constant body weight is of vital importance in increasing the life expectancy, as well as, quality of life of individuals and communities. It is a fact that exaggerated weight fluctuations on either side (underweight or overweight) of a desirable range of weight lead to an increase in the morbidity/mortality rate.

Prevalence

WHO (2018) estimates that about 462 million adults are underweight. At the same time, there are over 1.9 billion adults worldwide who are moderately or severely overweight. WHO states that world wide obesity has nearly tripled since 1975 and that the growth in the number of severely overweight adults is expected to double that of underweight adults during 1995-2025.

Now, let us have a look at the situation in developed countries. As per the report of National Health and Nutrition Examination Surveys (NHANES) conducted by the Centers for Disease Control and Prevention, 2015-16, currently 71.6% of U.S. adults age 20 years and older are overweight and 39.8% are obese. These figures stood at 70.7% and 37.9%, respectively during 2013-2014 implying thereby that there has been a consistent increase in prevalence of obesity.

The increase in prevalence of obesity among children also is a cause of great concern. Estimating true prevalence is difficult because of the lack of agreement of different bodies in defining obesity in children and adolescents. However, data from 79 developing countries and a number of industrialized countries suggests that, by WHO standards, about 41 million children under 5 years old are overweight or obese which 52 million children are wasted, 17 million are severely wasted & 155 million are stunted Worldwide (WHO, 2018)

Obesity in India

The results of a recently concluded study on the prevalence of obesity in urban Delhi by the National Family Health Survey-4 (2015-16) has projected that 24.6% of the

males and 33.5% of females belonging to the both urban and rural area are currently overweight with even higher prevalence of abdominal obesity. In India, these figures are 20.6% for women and 18.9% for men. If present trends continue, the situation can get worse even within a decade and overweight can emerge as the single most important public health problem in adults. This is despite the fact that one fourth of our country's population still falls below the poverty line. So we have learnt that :

- * 462 million adults are underweight while 1.9 billion are overweight.
- * During the past 10 years there is 2.4% rise in overweight and 3.9% rise in obese Americans while there is 2.6% rise in percentage of obese children (5-14 years).
- * Roughly 140% of Indians belonging to the both urban and rural areas are over weight. With increasing numbers every years, obesity could become a public health problem in adults.

Classification

Obesity is defined as a condition with accumulation of excess body fat. Do you think that a measure of how much fat a person has in its body would serve as a tool for classification of obesity? No, because the measurement of direct body fat is difficult, so we use an indirect method, a ratio called the Body Mass Index (BMI) also termed Quetelet's index. This ratio estimates dependence on frame size and provides the most useful method of measuring obesity in populations. BMI can be calculated from the following equation:

$$\text{BMI} = \frac{\text{Weight (kg)}}{\text{Height (m)}^2}$$

where kg = kilogram, m = metre

By this method, various grades of obesity, normal and underweight can be known. Our BMI value near 18.5 to 24.9 is the ideal value for us to remain healthy and enjoy a quality life. Table 9.1 presents the weight status according to the BMI range.

Table 4.2: Weight status according to BMI

Classification	BMI (kg/m ²)	
	International	Asian
Underweight	<18.5	< 18.5
Normal	18.5-24.9	18.5-22.9
Overweight	25.0 - 29.9	23.0-24.9
Obese	≥30	≥25
Obese (Grade I)	30-34.9	
Obese (Grade II)	35.0-39.9	
Obese (Grade III)	> 40	

*Source: WHO (2004)

So have you calculated the ratio for yourself? You can keep it a secret if you so desire.

Interestingly it has been found that for a given BMI, Indians have more body fat than other ethnic groups, both within and outside Asia. This relative increase in

adiposity in Indians has led to the suggestion that the BMI cut-off for non-communicable diseases such as obesity should be reduced for Indians to about 23 kg/m² or lower. In other words refer to it as a public health action point at a BMI of 23 kg/m².

So then adiposity can be inferred from the BMI, however, this may not be sufficient to fully explore relationship between body fat and alterations in human health. Besides, the BMI, the location of the fat in the body is also important. In this context the measurement of waist and hip circumference and their ratio is crucial. The waist to hip ratio is described next.

Waist to Hip Ratio (WHR)

Two individuals who have the same BMI and the same total body fat may have different abdominal fat mass. Abdominal fat accumulation increases the risk of a number of chronic degenerative diseases.

The waist-hip ratio (waist circumference divided by hip circumference) therefore is a simple method for distinguishing between fatness in the lower trunk (hip and buttocks) and fatness in the upper trunk (waist and abdomen area). A WHR of >1.0 for men and >0.85 for women is an indicator of abdominal obesity. Lower trunk fatness (i.e. lower waist to hip ratio) is often referred to as 'gynoid obesity'. Upper trunk or central fatness (higher waist to hip ratio) is called 'android obesity'.

How do you make these measurements? Waist and hip measurements are taken on standing posture and the unit used is centimeter. Waist is measured around the navel and hip is measured around its broadest part. You may have realize that in addition to having a normal BMI value, it is also important for us to have a normal WHR to have a healthy, as well as, attractive body.

Next, let us learn about the classification of obesity and underweight in children.

Obesity in Children

It is difficult to measure overweight or obesity in children and adolescents because they grow and mature at different rates. Weight status in children can be classified based on percentile curves for BMI for age as per the WHO Technical Report (1995). Table 9.2 presents the weight status based on percentile curves of BMI for age.

Table 9.2: Weight status based on percentile BMI for age

Weight Status	BMI for age
Underweight	< 5 th percentile
At risk of overweight	≥ 85 th to <95 th percentile
Overweight	≥ 95 th percentile
Overweight or at risk	≥ 85 th percentile

The latest BMI for age percentiles for boys and girls 2 to 20 years have been published by the United States National Center for Health Statistics (NCHS) in collaboration with the National Center for Chronic Diseases Prevention and Health Promotion in the year 2000 which may be applied to affluent Indian children also.

Now that we are clear about how to classify obesity and underweight, we will further look at the guidelines for calculating the ideal body weight.

9.3 GUIDELINES FOR CALCULATING IDEAL BODY WEIGHT (IBW)

What is the ideal body weight for me? Am I obese? Am I underweight? These are the questions that must have come to your mind as you stepped into your teens. The three main factors that determine your ideal weight are your age, sex and height. You have already learnt in the previous section about two important indices of body weight that help in the evaluation of your current weight status, i.e., calculation of BMI and the measurement of WHR. In addition, you have standard height and weight charts for adult males and females that help you to determine the range of weight which is appropriate or desirable for you at a given height.

You must appreciate that the best weight for a given individual's height, age, bone structure and muscular development is not known exactly. A lot of people continue to gain weight till the fourth or fifth decade of their life which is neither inevitable nor physiologically necessary. In general, the best weight is the weight at which you both look and feel your best. The life insurance statistics, on which the height weight standards are normally based, tell us that the most nearly ideal weight to maintain throughout life is that which is proper at the age 25 for your height and body build. Age, of course, is an important factor in determination of body weight in the growing stage, i.e., for children. Table 9.3 and 9.4 below give the standard height and weight charts for Indian adult males and females and also for children at different ages. You can also use these charts to assess whether for your height the weight is ideal or not.

Table 9.3: Standard height and weight For indian men and women

Height	Men		Women	
	Weight (kg.)	Weight (lb.)	Weight (kg.)	Weight (lb.)
1.52 M (5'0")	–	–	50-54	112-120
1.54 M (5'1")	–	–	51-55	114-122
1.57 M (5'2")	56-60	124-133	53-56	117-125
1.59 M (5'3")	57-61	127-136	54-58	120-128
1.62 M (5'4")	59-63	130-140	56-60	124-132
1.65 M (5'5")	61-65	134-144	58-61	127-135
1.67 M (5'6")	62-67	137-147	59-64	130-140
1.70 M (5'7")	64-68	141-151	61-65	134-144
1.72 M (5'8")	66-71	145-156	62-67	137-147
1.75 M (5'9")	68-73	149-160	64-69	141-151
1.77 M (5'10")	69-74	153-164	66-70	145-155
1.80 M (5'11")	71-76	157-168	67-72	148-158
1.82 M (6'0")	73-78	161-173	69-74	151-163
1.85 M (6'1")	75-81	166-178	–	–
1.87 M (6'2")	77-84	171-184	–	–

Table 9.4: Height and weight of Indian children

Age	Height		Weight	
	Male (cm)	Female (cm)	Male (kg)	Female (kg)
3 months	56.8	56.0	5.2	5.1
6 months	62.8	61.7	7.0	6.6
9 months	68.9	66.8	8.0	7.7
12 months	72.8	70.7	8.6	8.3
1-2 years	82.61	79.89	10.94	10.21
2-3 years	91.14	89.63	12.79	12.11
3-4 years	98.36	96.21	14.78	13.79
4-5 years	104.70	104.19	16.12	15.85
6 years	118.9	117.3	22.1	21.4
7 years	123.3	122.7	24.5	24.3
8 years	127.9	126.8	26.4	26.1
9 years	133.6	132.3	30.0	29.7
10 years	138.5	138.5	32.4	33.5
11 years	143.4	144.1	35.3	36.5
12 years	148.9	150.3	38.8	42.6
13 years	154.9	153.0	42.9	44.4
14 years	161.7	155.1	48.3	46.7
15 years	165.3	155.3	52.2	48.2
16 years	168.4	155.4	55.4	49.8
17 years	168.9	156.4	59.0	49.9
18 years	169.4	157.2	62.0	50.0

Compiled from 'A Textbook of Foods, Nutrition and Dietetics' (2nd Rev. Ed.), Raheena Begum, 1997.

Check Your Progress Exercise 1

- Fill in the blanks:
 - WHO 2018, estimates that million adults are overweight while million adults are underweight.
 - About 41 million children in the age group of years are overweight worldwide.
 - Currently million children are wasted and and million children are stunted worldwide.
 - A WHR of greater than for men and greater than for women is an indicator of abdominal obesity.
- What method is used for classifying a person overweight? How is it calculated?

- What are the factors that determine one's ideal body weight?

4. Match the items in Column A with the items in Column B.

Column A

- i) WHR
- ii) Underweight
- iii) Ideal BMI
- iv) Overweight
- v) Obesity (grade I)

Column B

- a) <18.5
- b) >0.85 for women
- c) >95th percentile
- d) 18.5-24.9
- e) 30 to 34.9

Having learnt about the IBW and how the weight status can be classified, we shall now consider the problem of obesity and underweight in a detailed manner. Let us take up obesity first.

9.4 OBESITY

Obesity is a condition resulting from accumulation of excess body fat. The fat deposition takes place because over a period of time, people consume diets which provided much more energy than they were able to expend for their metabolism, physical activity and growth. The prevalence of obesity in developing countries has increased. This is because communities have emerged from a life style of subsistence towards a life style of affluence. In India, there has been an increased migration of the rural population to urban areas. This shift also has been a contributing factor to life style changes including significant reduction in physical activity leading to changes in weight.

Let us look at the factors that contribute to obesity.

9.4.1 Etiology

What are the causes of obesity? However simple the question may sound, the answer to it is not all that simple. We cannot deny that excess weight results from positive energy balance or consistent consumption of excess calories than the body is able to expend. This means that obesity can be corrected by balancing the intake and output of calories consumed and expended. Thus, it is not an easy task to accomplish because obesity is the net result of a complex interplay of genetic predisposition towards fat storage and a number of environmental factors that determine the weight status of an individual.

We cannot change our heredity but we can, to a certain extent, exercise control over environmental factors by carrying out suitable modifications in our life style. Indians as an ethnic group are at a disadvantage. It is a fact that for a given degree of obesity or BMI, Indians have higher body fat percent and visceral fat (fat around internal organs) than other populations which increases the risk of chronic degenerative diseases in later life. Let's enumerate the various etiological factors for obesity. We will learn about each of them in detail also.

- Genetic susceptibility
- Dietary habits
- Physical activity
- Affluence and abundant availability of food
- Psychological factors
- Hormonal imbalance
- Birth weight and childhood growth pattern

Genetic Susceptibility: Some people inherit a tendency to become fat. Earlier, it was thought that genetic inheritance ranged from 66% to 80% but now it is believed that our chances of inheriting our parent's BMI is about 33%. Obesity or thinness of an individual is inherited, basically from the biological mother. If our biological mother has been overweight as an adult, the likelihood of our being heavy is about 75%.

A number of genes are implicated in *pathogenesis of obesity*: The two genes which recently have received much attention are the *ob gene* and the β_3 - *adrenoreceptor* gene. The *ob gene* produces leptin (a hormone) which is normally secreted from fat cells. Mutations in the *ob gene* cause obesity. Treatment of obese mice with leptin has shown to reduce food intake and body fat. Some scientists are of the opinion that the *ob gene* may not have a major role to play in human obesity.

The β_3 - *adrenoreceptor* gene is basically located in adipose tissue. It regulates Resting Metabolic Rate and oxidation of fat in human beings. A mutation in this gene may lead to weight gain. In some individuals, it may increase the body's ability to store fat when food is limited and cause an increased risk of obesity when plenty of food is available and energy expenditure is reduced. However, this does not mean that it is inevitable for a person to be obese because of genetic mutations. Expression of the genetic tendency may be controlled by appropriate life style modifications also.

Dietary habits: You are aware that a positive energy balance is one of the major contributory factors for obesity. Some people are in the habit of eating too much food. They may also be ignorant about the caloric values of common foods like butter, cheese, jam or rich baked snacks and desserts, the extra helpings consumed rapidly increase the amount of calories ingested. Sometimes maintaining social relationships also contributes to intake of excess calories. As you advance in age, your metabolic rate slows down and you require less energy to carry out the same set of activities than that needed 20 years ago. On the same diet and eating habits you will definitely put on weight. It is believed that women are more likely to be obese in the age group 40-60 years across all geographical regions.

Besides the diet *per se*, there are certain eating habits which may lead people to obesity, e.g., those who eat food at a very fast rate tend to chew food less and land up eating more food. Similarly, nibbling between meals may contribute significantly extra calories to the total intake than is normally realized. Also, those who tend to eat whenever food of their liking is available or those who just follow meal times even if they are not hungry tend to put on weight. Mothers generally eat leftovers of children because they want to avoid wastage of food, adding on more calories to their own calorie intake.

Physical activity: Sedentary life style with lack of an exercise schedule tends to make one obese. As we approach middle age, our physical activity generally decreases without a corresponding decrease in food consumption leading to obesity. Activity may be decreased because of a debilitating illness like arthritis or cardiac disease. A change of occupation or simply because of the fact that period of quiet, rest and relaxation have increased, may lead to decreased activity. In addition, when we are more active, the body prefers to metabolize fat as an energy source leading to a decrease in the adipose tissue.

Affluence and abundant availability of food: With increasing affluence, increase in purchasing power and abundance of food, people tend to eat more. Intake is more when people are offered a variety of foods than when a single food is available. Eating out has become fashionable leading to an increased consumption of junk food which is rich in calories and short on essential nutrients. The ready availability of and preference for high fat and/or fast foods also contributes to obesity.

Psychological factors: Lonely, bored and depressed individuals may find solace in eating. When there is nothing else to do, eating provides diversion resulting in increased consumption of calories.

Hormonal imbalance: Certain diseases associated with secretion of hormones, e.g., hypothyroidism, hypogonadism and Cushing's syndrome exhibit obesity as one of the characteristic features. A large number of persons who are unsuccessful in reducing their weight tend to site hormonal imbalance as causative factor for their obesity but the fact is that only a very small percentage actually suffers from it. Diagnostic tests are available which help in finding out if a person is actually suffering from hormonal imbalance.

Birth weight and childhood growth pattern: It has been shown that slow growth of the foetus in utero and during infancy is followed by accelerated weight gain in childhood. This combination of small size at birth and accelerated childhood weight gain has been found to be associated with exaggeration of adiposity, as well as, insulin resistance in later life. So can we say that small size at birth and accelerated childhood weight gain is a predictor of later obesity? Yes, we can.

Having looked at the etiological factors, next let us understand the concept of energy balance.

9.4.2 Energy Balance

Obesity is a state of positive energy balance created by consumption of calories in amount excessive to the total energy expenditure (TEE) by the body. TEE comprises the following:

- Resting Energy Expenditure (REE) – 60-75% of TEE
- Thermic Energy of Food (TEF) – 10% of TEE
- Energy Expended on Physical Activity (EEPA) – 15-30% of TEE

REE is the energy required to sustain normal body functions like circulation, respiration, pumping of ions across membranes, synthesis of various compounds, maintenance of body temperature etc. The extent of this expenditure depends upon body size and composition.

TEF is the energy expended to digest, absorb and metabolize food including synthesis and storage of various nutrients.

EEPA is the most variable component of total energy expenditure and includes energy expended in voluntary exercises like in walking, cycling, swimming etc. as also that expended involuntarily e.g., in shivering and fidgeting. The sum total of REE, TEF and EEPA gives us the value for total energy expenditure(TEE).

Total Energy Expenditure	=	Resting Energy Expenditure	+	Thermic Energy of Food	+	Energy Expended in Physical Activity
(TEE)	=	(REE)	+	(TEF)	+	(EEPA)

You are aware that the total energy derived from the food that we consume can be calculated from the energy provided by protein, fat and carbohydrates present in the food. Energy provided by 1gram of protein = 4 Kcals, 1 gram of fat = 9 Kcals and 1grams of carbohydrate = 4 Kcals.

Weight status is maintained when the total energy derived from food intake equals the total energy expended by the body. We tend to lose weight when less energy is derived from food than is expended. Let us see what happens when an individual is consuming daily, say, 100 Kcal over and above the amount he is able to expend.

Extra calories ingested/day = 100 Kcal

Extra calories ingested/month = 3000 Kcal

Now 1kg adipose tissue represents = 7700 Kcal (1 gm adipose tissue = 7.7 Kcal)

Weight gain/month = $3000 \div 7700 = 0.38$ kg approximately

Weight gain/year = 4.56 kg

You will appreciate that if this continues for a period of, say, five years, theoretically, even before the person realizes, he is transformed into a grossly obese individual. It is hard to believe that as little as one extra chapatti or two teaspoons of butter everyday will result in about 20 kg weight gain over a period of five years. Even though in effect, weight is not deposited in as direct proportion as this. Let us see why. With the increase in energy intake, energy output is affected in a number of ways. Firstly, as the quantity of food ingested is increased, thermogenic effect of food would also increase amounting to about 10% of the excess intake. Secondly, the energy stored would increase both the fat and the fat-free mass resulting in an increase in metabolic rate. This adaptation of metabolic rate which tends to oppose fluctuation in weight does not permit weight gain in direct proportion to increase in caloric intake.

The thermodynamics of weight loss is a bit less complicated. As opposed to the great metabolic cost involved in storage of excess dietary calories as fat, protein or glycogen, hardly any metabolic cost is involved in mobilization of these stores.

Plateau effect: You must have noticed that when people start following weight reducing diets, they lose weight rapidly in the beginning, then a little slowly and finally a plateau is reached when they no longer lose weight. Initially, glycogen stores (sugar stored in liver) are mobilized which is accompanied by a corresponding loss of water. Then, as weight is lost, it results in loss of extra muscle which was developed to support the extra adipose tissue. Loss of lean body mass reduces the RMR rapidly so that on a given diet, the energy deficit is reduced and the rate of weight loss slows down. Weight loss stops at this point unless a change is made either in nutritional intake or physical activity. This fact has been hypothesized as “set-point theory”.

Weight cycling: There are a number of obese people who keep losing and gaining weight a number of times in their lives. This is called the *Yo-yo effect*. Every time they regain lost weight, it takes longer to lose the same amount of weight and also less time to regain it. This frequent losing and gaining of weight is associated with health risks related to normal functioning of the heart. Psychologically also repeated weight gain is quite demoralizing for the obese individual. Withstanding, any amount of intentional weight loss results in significant reduction in all cause, cardiovascular and cancer mortality.

Adipose tissue: At this point, it will not be irrelevant to consider how exactly does an increase in the fat depot take place. For understanding obesity better, it is important for you to know that fat is stored as triglyceride in fat depots made up of adipose tissue. A normal adult woman has about 20% to 25% of her body weight as fat while in men appropriate body fatness is 12% to 15% of body weight. When we put on weight, there is an increase in the adipose tissue. This may either be a result of hypertrophy or hyperplasia of adipocytes (fat cells) or a combination of the two processes. Hypertrophy means increase in the size of adipocytes already present in the body while an increase in their number is known as hyperplasia. As an adult we put on weight mostly by hypertrophy of fat cells although in some forms of obesity hyperplasia may also be there. Hyperplasia basically occurs during infancy and adolescence as a part of growth process. Fat cell size decreases when we lose weight for any reason but weight loss does not involve a decrease in the number of adipocytes.

Brown fat and white adipose tissue (WAT): There are two kinds of adipose tissue. Brown Fat is located around the shoulder blades and kidneys, constituting 1-2% of body weight. It is highly vascular which is the reason for its brown colour. It is capable of producing a large amount of heat for cold adaptation by burning of excess energy. It is a site for conversion of thyroid hormone, thyroxine, to its biologically active form. White adipose tissue acts as a cushion to protect abdominal organs and is the fat that accumulates under the skin. Earlier, it was thought that WAT is passive and acts only as a fat storage depot. WAT, in fact, is a smart tissue and has a number of functions to perform. It has now been realized that WAT is an endocrine organ, which besides some other factors, secretes a hormone leptin. Leptin seems to have a role to play in

reducing appetite or increasing satiety and also in regulation of the energy balance. A deficiency of leptin, therefore, is conducive to obesity. Adipocytes in WAT also have a number of hormone receptors on their cell surfaces. That is why individuals with abdominal obesity are prone to developing insulin resistance which initially causes impaired glucose tolerance and ultimately may cause Diabetes mellitus.

Let us learn about the metabolic aberrations and clinical manifestations of obesity next.

9.4.3 Metabolic Aberrations and Clinical Manifestations

The state of obesity brings about certain alterations in the normal body processes which are enumerated herewith and highlighted in Figure 9.1.

Deranged lipid profile: Lipids, as you are already aware, are important dietary constituents that include fats, steroids, phospholipids and glycolipids. A number of vitamins and essential fatty acids are associated with them. In obese individuals, the lipid profile is usually deranged. The triglyceride values are generally high and HDL cholesterol is low. Both triglycerides and HDL cholesterol are synthesized from products of digestion of dietary fats. With weight reduction, both these levels come back to normal.

Insulin resistance: Insulin resistance is a condition in which your body cells cannot utilize insulin efficiently although sufficient amounts are secreted by the pancreas. Obesity is a contributing factor towards insulin resistance. Because sufficient insulin is being produced but the body cells are not able to use it, the blood insulin levels become high (hyperinsulinaemia). This affects the utilization of glucose leading to high fasting blood sugar levels and abnormal glucose tolerance. In addition, levels of plasma glucagon (a hormone produced by pancreas having an effect opposite to that of insulin), free fatty acids and uric acid also are found to be elevated in obese individuals. All these altered biochemical parameters get back to normal as weight loss is affected.

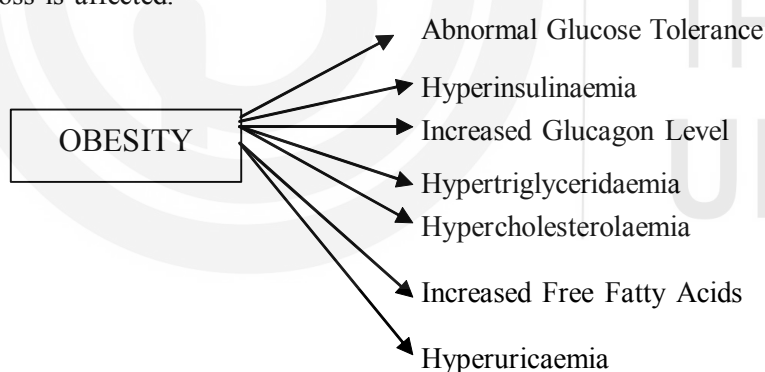


Figure 9.1: Altered biochemical parameters in obesity

The clinical manifestations are highlighted next.

Clinical manifestations: You must have observed that your overweight friends and colleagues seem to have less energy which makes them an easy prey for fatigue. They are also less agile and more likely to fall because of imbalance. They have a tendency to have high blood pressure and dyspnoea (breathlessness on exertion). Many of them may have increased susceptibility to developing skin disorders such as heat rash, intertrigo (superficial inflammation of two skin surfaces that are in contact with each other such as between thighs), candidiasis (a fungal infection) and acanthosis nigricans (dark, warty growths in skin folds like groin, armpits and mouth).

What are the consequences of obesity? Let us read and find out.

9.4.4 Consequences

Obesity has a number of adverse effects and is a risk factor for several problems as highlighted in Figure 9.2. It is a risk factor for all causes of mortality and morbidity.

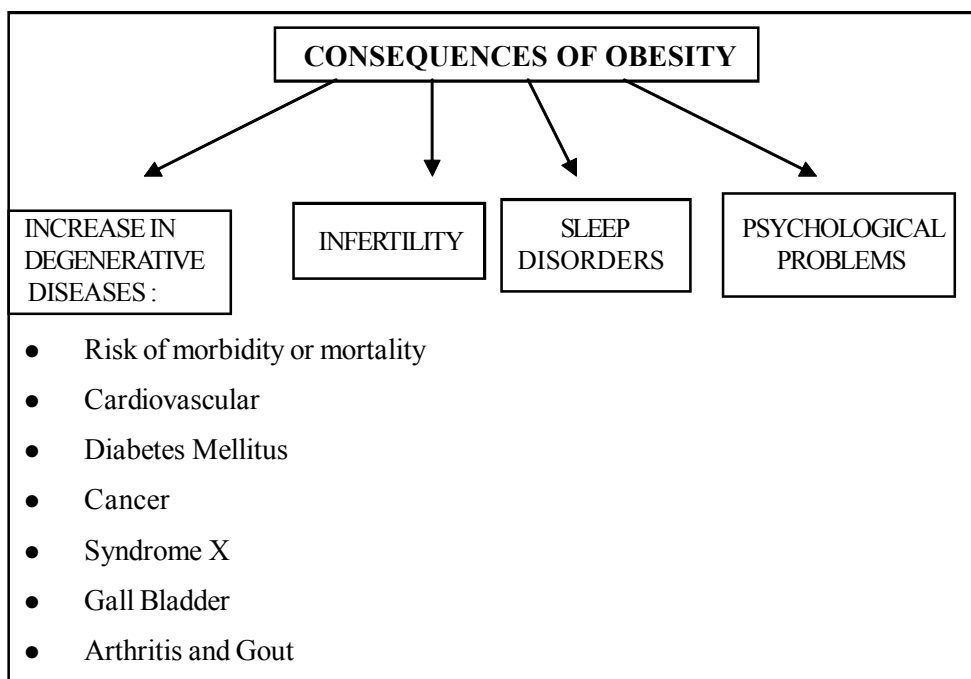


Figure 9.2: Consequences of obesity

Let us know more about the consequences of obesity and deal with each aspect briefly.

General mortality and morbidity risk: Obesity increases the risk of morbidity and mortality. The obese are more prone to developing morbidities or other chronic diseases like, cardiovascular disease including hypertension and dyslipidaemia, non-insulin dependent diabetes mellitus, gall bladder disease and gout. The risk of developing some non-fatal conditions like arthritis, back pain, infertility, sleep disorders and other respiratory conditions leads to increased morbidity among the obese. Let's discuss these conditions in slightly more detail.

Cardiovascular disease and stroke: Obesity may be an independent risk factor for coronary heart disease (CHD) with the degree of obesity being directly proportional to the rate of development of CHD as you would also learn later in Unit 11. Even moderate overweight has been shown to increase the risk of CHD. A reduction in weight leads to improvement in cardiovascular risk factors like hypertension and abnormal lipid levels. The blood pressure returns to normal and the lipid profile improves.

When the blood vessels of the brain are diseased, they may rupture or there may be inadequate blood supply to brain resulting in a stroke. This may be due to hypertension or fatty deposits in blood vessels of the obese.

Type 1 Diabetes: In people with normal weight, Type1 Diabetes is not a major cause of death but it is an important contributor to morbidity and mortality in obese people. It is associated with insulin resistance and hyperinsulinaemia (increased level of circulating insulin in blood). Fortunately, reasonable control in blood sugar levels may be achieved by modification in the lifestyle. A balanced diet, physical activity and drugs can control blood sugars and an obese can lead a near normal life.

Syndrome X: People with intra-abdominal obesity with high waist- to- hip ratio are more prone to develop the metabolic syndrome X. This is characterized by the collective presence of chronic disorders that include glucose intolerance, insulin resistance, hyperlipidaemia and hypertension. The syndrome X is one of the major public health problems associated with obesity.

Gall bladder disease: Obesity is one of the risk factors for formation of gallstones. The supersaturation of bile with cholesterol in obese individuals makes them prone to having gallstones as you will learn later in Unit 15. The excess adipose tissue is also known to contain a large amount of cholesterol. Weight loss does not reduce the risk

of gallstone formation because the mobilization of adipose tissue may cause the bile to become even more saturated with cholesterol in obese people.

Cancer: Risk of cancers of the colon, rectum and prostate increases greatly in obese men while obese women are more likely to develop cancer of breast, ovary, endometrium and cervix.

Back pain, arthritis and gout: Abdominal obesity increases the risk of back pain because of the extra load on the spinal column. This, in turn, reduces physical activity leading again to an increase in adiposity.

Obesity is also associated with the development of osteoarthritis and gout. The extra stress on the weight bearing joints is a contributing factor. Obese are prone to developing hyperuricaemia (excess uric acid in blood) resulting in gout. We will learn more about this later in Unit 13.

Infertility: Obese women are reported to suffer more from menstrual disorder, infertility and polycystic ovary syndrome all of which tend to improve on reduction of weight.

Sleep disorder: One of the common problems that obese males and females suffer from is sleep disorder, commonly known as sleep apnoea. Obesity causes narrowing of the upper airway when the person is in supine position. This can result in sudden death in severe cases.

Psychological problems: Obese people may be exposed to ridicule and discrimination in areas like employment, promotions and social interactions. This may result in low self-esteem and depression leading to overeating for consolation. This aggravates the existing problem further. Although it is increasingly being understood that obesity is a complex interaction of metabolic, physiological, and genetic factors, obese people are still viewed as being weak-willed and self-indulgent.

After a detailed study of various factors related to obesity, let us now move on to the management and prevention of this multidimensional public health problem. In the forthcoming section we shall discuss the strategies for achieving a negative energy balance, as well as, the steps that must be considered for prevention of obesity. However, let us first make an effort to check our understanding on the issues discussed above.

Check Your Progress Exercise 2

1. State whether the following statements are true or false. Correct the false statements.
 - a) When people are offered variety of foods, their intake is likely to be less than when a single food is available.
 - b) Hyperthyroidism and Cushing's Syndrome have obesity as one of their characteristic features.
 - c) One kilogram dietary fat represents 9000 Kcals.
 - d) Losing and gaining weight by the obese throughout life cycle is termed as the yo-yo effect.
 - e) Obesity predisposes to hypoinsulinemia and decreased glucagon levels.
 - f) Energy expended in physical activity is 60-75% of total energy expenditure.
 - g) The Resting Metabolic Rate is regulated by the *ob gene* in human beings.

2. What is obesity? Enumerate the various etiological factors.

.....

.....

.....

3. Give reasons for the following:

a) An increase in weight gain is not directly proportional to an increase in calorie intake.

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b) People lose weight rapidly in the beginning when they start following weight reducing diets.

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.....

.....

c) A deficiency of leptin is conducive to obesity.

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4. Briefly discuss the metabolic aberrations of obesity?

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5. List the fatal, as well as, non-fatal conditions for which obesity is a risk factor.

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.....

9.5 MANAGEMENT OF OBESITY

Management of obesity should be taken up with a clear understanding of the harsh realities of the problem and its outcome. It may be a frustrating experience for the physician and the nutritionist because of the frequent failures encountered during the treatment. You have already read about multiple etiological factors causing the chronic condition, the cause of which is difficult to pin-point. This makes the treatment even more difficult. The lost weight is frequently regained by the obese which may be demoralizing for continuing the necessary changes in the diet and physical activity.

Goals of treatment: As said in the beginning, the goal of treatment of obesity today has shifted from mere 'weight loss' to 'weight management'. Each weight loss programme has to have its separate set of goals keeping in view the overall health of

the individual. A loss of as little as 5-10% of the original body weight by the obese results in significant improvement of health and helps in reducing the severity of the comorbidities or the risk factors associated with obesity. Studies have shown that even with a 5-10% weight reduction, an obese has better glycemic control, and lowered blood pressure and serum cholesterol levels. Hence it may not be realistic for the obese to always have singular focus of coming down to the desirable weight. Obsession with desirable weight may actually be inappropriate in some cases under certain circumstances. So let us see what is the best approach to manage obesity.

9.5.1 Dietary and Lifestyle Modifications

The management of obesity basically comprises the following three- pronged approach.

- a) Dietary modifications
- b) Physical activity
- c) Behaviour and lifestyle modifications

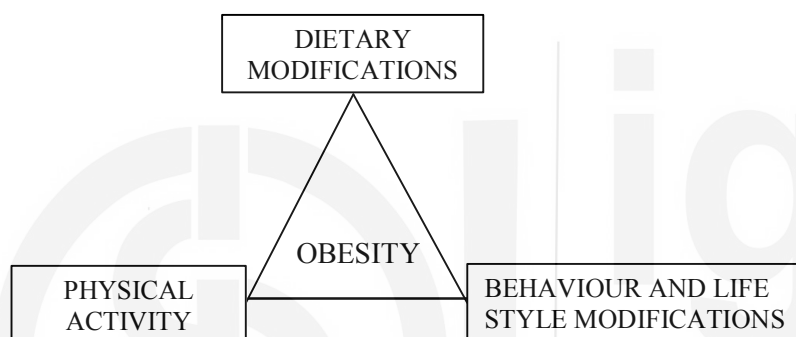


Figure 9.3: Management of obesity

Some cases where obesity is accompanied by certain comorbidities at higher BMI values, the use of drugs and/or surgery may need to be considered. Pharmacological and surgical interventions are required in relatively few cases and should not be construed upon as substitute for necessary changes in diet and physical activity. We shall deal with them individually a little while later in subsections 9.5.2 and 9.5.3 respectively. Let us begin our study with dietary management.

a) Dietary Modifications

The dietary modifications serve as a guide for the obese to make healthy food choices. The first step towards prescribing a diet for weight reduction is to take a careful dietary history of the obese person. You need to know the routine eating pattern, the diet he/she is accustomed to, availability of foods and the likes and dislikes. Determine the ideal weight from the height-weight tables given earlier in section 9.3. The daily diet plan should have an energy deficit of 500-1000 Kcal in general. It is also important for us to know whether the person has tried to lose weight earlier too and what advice was given then and why was the outcome unsatisfactory. All this information can be gathered in a few minutes and this could form the basis of providing appropriate advice to the obese for losing weight. The following dietetic principles must be considered while planning diets for weight reduction. Of course, you will be learning more about this aspect in your practicals too. So let us learn about the dietary guidelines.

Energy: Energy or calorie intake is the key factor which will determine the outcome of dietary management for overweight/obese individuals. You will appreciate the fact that to effect any degree of weight loss, the energy has to be restricted to the level that enables mobilization of fat stores for carrying out the daily activities of the body.

The energy requirements can be determined on the basis of ideal body weight. Three main categories, depending upon the individual's size and level of activities have been determined on the basis of ideal body weight and have been mentioned in Table 9.5.

Table 9.5: Energy requirements based on activity levels for obese, normal and underweight subjects

Energy Requirements* (Kcal/kg IBW/day)			
Activity	Obese	Normal	Underweight
Sedentary	20-25	30	35
Moderate	30	35	40
Heavy	35	40	45-50

Note: * refers to $\pm 10\%$ for small and large build.

Using the values given in Table 9.5, we can compute the energy requirements for obese, normal and under weight adults for various levels of activity. Since the basal metabolic rate is affected by the type of build, it is imperative to increase or decrease the energy intake by 10% depending on the build (exomorphs and endomorphs, respectively). However as a thumb rule or in the absence of data on height, the following diets are often prescribed.

1. Moderate Deficit Diet (For pre obese) : 1400 Kcals/day and above for males
1200 Kcals/day for females is safe for use
2. Low Calorie Diet (For obese): 800 to 1400 Kcals/day for males
800 to 1200 Kcals/day for females use under medical supervision
3. Very Low Calorie Diet (For very obese) : Less than 800 Kcals/day use under (VLCD) medical supervision

Despite calorie restriction, all the above diets must be nutritionally adequate. In general, it is safe to use the moderate deficit diets providing 1200-1400 Kcals and low calorie diets that provide minimum of 1000 calories/day. They can be planned to provide optimum nutrition and offer sustainable weight loss. The VLCDs providing 400-800 Kcals/day on the other hand promote rapid weight reduction but must be followed under close supervision of physician and dietician and that too, for a limited period of 12 to 16 weeks to minimize the risk of body protein losses and cardiac problems. They may only be considered for the obese with a minimum BMI of 32.

REMEMBER IT IS SAFE TO USE MODERATE DEFICIT DIETS PROVIDING 1200-1400 KCALS/DAY. LOW CALORIE AND VERY LOW CALORIE DIETS MUST BE USED UNDER STRICT MEDICAL CARE FOR LIMITED PERIODS.

Proteins: Adequate amount of proteins should be included in the diet to ensure proper metabolism and prevent weakness which is usually experienced by patients after weight loss which is achieved by consuming an unbalanced diet. Protein rich foods provide a higher satiety as compared to those rich in carbohydrates (other than non-starch polysaccharides). Proteins also have a high specific dynamic action which implies that their ingestion produces a greater increase in metabolism than ingestion of carbohydrates or fats – an important aspect when you are trying to lose weight. Include

about *1g protein per kg body weight*. Emphasis should be laid on the inclusion of protein rich foods from plant origin rather than from animal sources as the former are low in fat but high in dietary fibre.

Fats: Fats, being a concentrated source of energy need to be restricted. Excess dietary fat promotes much more weight gain than carbohydrate or protein of the same amount. Further, the gain in weight due to excess intake of fat is in the form of adipose tissues which is not conducive to good health. Include fat in the form of vegetable oils (rich in MUFA's and PUFA's) so that sufficient essential fatty acids are supplied in the diet and at the same time the risk of developing coronary artery disease can be minimized. Not more than 20% of the total energy should come from fat. Foods rich in saturated fatty acids such as red meats, whole milk/its products should be strictly avoided.

Carbohydrates: Carbohydrates in the form of non-starch poly-saccharides provide bulk and satiety value to the reducing diet. They are also important for regular bowel movements; constipation being a common problem among obese. About 50-55% of total calories may be from complex carbohydrates and 10% from simple carbohydrates. Include liberal amounts of fresh high fibre vegetables and fruits preferably raw and with their edible peels in the diet.

Vitamins: If adequate amount of fresh fruits and vegetables are included in the diet, the body stores of water soluble vitamins are usually not depleted. However when we restrict fats for prolonged periods, the diet may be deficient in fat-soluble vitamins A and D. They may need to be supplemented for the chronic cases.

Minerals: A diet high in sodium may promote retention of fluid in the body. Moderate restriction in the use of common/table salt may be helpful in a weight reducing diet, particularly if the patient is also hypertensive.

Fluids: Liberal amounts of water and zero/low calorie fluids may be included in the diet. It may be helpful to have a glass of water before meal to reduce food intake. Some patients benefit by taking a spoon of guar-gum/pectin/xanthum gum or finely ground husk/bran of cereals and pulses in glass of water before meals as it gives a feeling of satiety.

Mentioned below is an example of a weight reduction diet (1200 Kcal) along with a sample menu to give you an idea regarding the applied aspects of the parameters discussed so far.

EXCHANGE LIST FOR PLANNING 1200 KCAL DIET

Food	Amount (approx.) per exchange (g)	CHO (g)	Protein (g)	Fat (g)
Milk (double toned)	250	24	16	7.5
Vegetables	100-150	3.5	2	—
Fruit	80-100	10	1.0	—
Cereal	25	18.8	2.5	—
Pulse	30	17	7	—
Fat	5	—	—	5

This is just an idea given to you for calculating a 1200 Kcal diet. You will learn more about food exchanges and planning of meals in the practical Manual (MFNL-005).

Below a sample menu for a day is given by using above exchange list:

Sample Menu for 1200 Kcal Diet

Early Morning	:	Tea/coffee, Plain
Breakfast	:	1 slice cracked wheat bread 2 slices tomato 1 egg white (boiled) 1 tsp. green chutney 2 tbsp. cornflakes 1 glass double toned milk OR 2 spinach missi roti 1 medium bowl of curd 1 guava
Mid-morning	:	1 orange
Lunch	:	2 chapatties 1 bowl moong whole pulse 1 bowl cabbage vegetable 1 plate carrot and tomato salad with lemon dressing 1 bowl curd (Double Toned)
Evening	:	Tea/coffee plain
Dinner	:	1 cup clear vegetable soup 2 chapatties (wheat flour + soya flour) 1 bowl nutrinugget and pea vegetable 1 cucumber 1 bowl curd
Post Dinner	:	1/2 cup milk

It will occur to you that the menu is simple home-made food which has less fat (3 tsp), salt etc. but it is nutritious and filling. We know in a global scenario, a variety of foods are available – Italian, Continental, Chinese, Thai and what not. Eating out is a fashion and how we love it but you can imagine the calories that we add with yummy food. Eating out is all right if done occasionally but missing the home food daily is not advisable. Just see what it does to an individual slowly, gradually but surely – an early affliction of degenerative diseases!

SIMPLE TASTY HOME MADE FOODS PROVIDE LESS CALORIES.
KNOWING THE CALORIES IN THE FOOD HELPS TO MAINTAIN
WEIGHT.

You may or would experience several times that overweight/obese patients attain their lost body weight again and again particularly after leaving a weight reduction programme. This generally happens due to inadequate counseling of the patient regarding appropriate dietary habits. Proper dietary counseling gives the patient a clearer understanding regarding the association of food with weight gain/loss. Behaviour modification can result only through repeated counseling sessions and has therefore been identified as a long-term approach for management of the achieved weight loss. We shall now discuss some important aspects of diet counseling.

Diet Counseling

As discussed above diet counseling is a very important aspect of a successful weight reduction programme. The person who attempts weight loss should be suitably motivated

and should be armed with facts related to the whole exercise. Counseling can be given in person or to a group as you would recall studying in Unit 1. Individual counseling is of prime importance because that is required to establish realistic goals for the treatment so that you can relate to the diet and comply with the same. It is also important to take the dietary history of the patient and to know about his food habits and pattern of living for prescribing the diet schedule.

Group sessions have an importance of their own in the sense that they provide a platform to people having similar problems to share their experiences and exchange ways and means to bring about changes in their diets. The individuals are also likely to be motivated better when they compare their progress with others in the group.

Both individual and group counseling are associated with motivation and psychological support. There is no point in handing over a diet schedule to the patient unless he has some motivation for losing weight. To bring about a change in dietary habits is not easy because their foundation is laid in early infancy and childhood. You are not likely to change unless you are strongly motivated to do so. Improvement or maintenance of health is a very strong factor which the physician or dietician can use for motivating the patient to bring about the necessary changes. With their guidance at initial and follow up visits, this motivation can come from within the individual himself which will see him/her through the programme successfully.

The patient should be very clear about the fact that excess calorie intake has to be brought down to effect weight reduction. He/she also needs to understand the reasons of overeating and how to control the factors leading to the same.

The counseling sessions help in increasing knowledge regarding food facts. The obese may feel disheartened after a few weeks when they realize that the rate of weight loss has decreased. The individual must understand that there is a reduction in metabolic rate after some weight is lost. Despite careful adherence to the prescribed schedule, the rate of weight loss will decrease. For weight loss to progress further calorie restriction or increase in activity will be required, the latter is a better alternative.

Knowledge about calorie values of foods is another area which requires emphasis. Food exchange lists which group different food items having approximately the same calorie values are helpful in this regard. The individuals should know about portion control to enable them to stick to the prescribed diet. Many foods have low calories but when eaten in large portions contribute substantial calories in the diet. So how much should the patient eat is also important. You will learn more about food exchanges in the practical (MFNL-005).

Instructions about eating out are important. An obese must select judiciously from options available. For example any recipe that says cream of, creamy, buttered or fried is bound to be high in calories. A clear soup, broiled or roasted non-vegetarian dish or vegetables without sauces or thick gravies, salads without oily dressings and fruit instead of a rich dessert are better options for them. Excess socialization hinders the weight reduction programme. Eating light meals at home may be a good idea so that the obese could minimize on extra calories.

b) **Physical Activity**

You are already aware that exercise plays an important role in initiating and sustaining weight loss along with dietary and lifestyle modifications. Exercise promotes a sense of well being and increases bone density, as well as, cardiovascular strength. It helps in increasing the lean body mass in proportion to fat. Exercise burns glycogen stores paving the way for fat to be used as fuel.

What is the effect of physical activity on health?

The Surgeon General's report (1996) summarizes the effects of physical activity on health as follows.

Overall Mortality: Higher levels of regular activity are associated with lower mortality rates among adults and even moderate activity on a regular basis results in lower mortality rates than those who are least active. The risk of several degenerative diseases is also reduced, as highlighted in Figure 9.4.

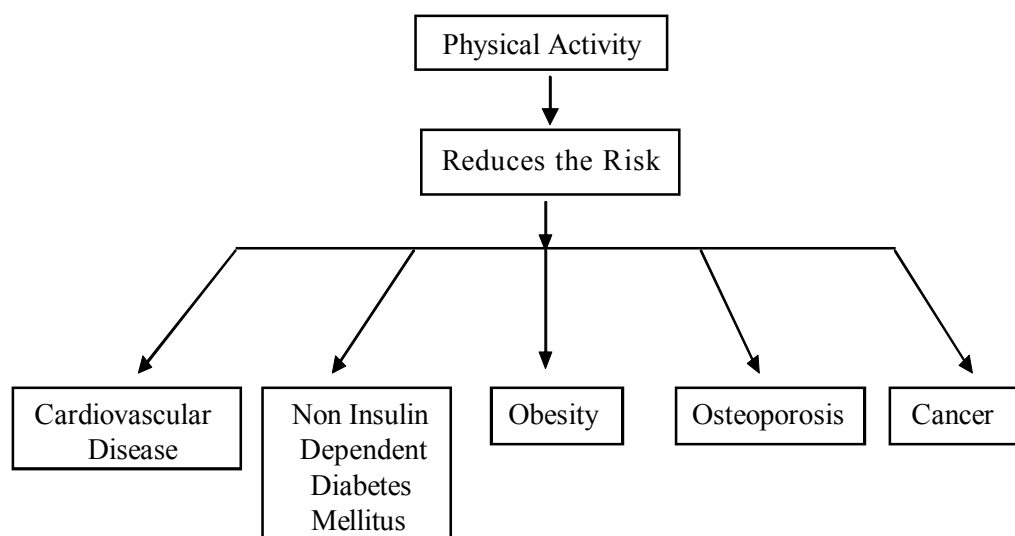


Figure 9.4: Effect of physical activity on health

How much physical activity is enough?

Although it is difficult to prescribe the optimum amount of physical activity, it is important to note that any exercise programme has to be consistent for affecting some degree of weight loss. It is recommended that 30 minutes or more of moderate intensity physical activity, even if accumulated in intermittent short spells at least five days a week (preferably everyday) should form a daily routine of all adults. A single 30 minute stretch may have the first 5 minutes for warming up, 20 minutes of moderate intensity exercise and 5 minutes of cooling down to prevent muscle injury. In any exercise programme, intensity should be increased only gradually with professional advice, especially for those who are above 40 years of age or have any health problems. In general, it helps to take stairs instead of lift, to take the glass of water yourself instead of asking somebody, walking to short distances instead of taking the car and in general being a little more active than before.

The exercise selected by an individual should be pleasant, enjoyable, affordable and easy to do. Practically speaking, the benefits of exercise besides its role in weight management can be summed up as follows.

- Exercise**
- * Reduces blood pressure
 - * Helps lessen angina pains
 - * Decreases body fats
 - * Increases HDL cholesterol
 - * Makes the heart stronger and more efficient
 - * Help in increasing bone density
 - * Reduces risk of cancers
 - * Increases longevity
 - * Offsets the immunity slump that accompanies aging

DAILY 30 MINUTES OR MORE OF MODERATE EXERCISE IS BEST FOR MAINTAINING IDEAL WEIGHT, HEALTHY FEELING, LONGEVITY AND GOOD IMMUNITY.

c) Behaviour and Life Style Modifications

Behaviour and life style modifications are an integral part of the weight reduction plan. They are based on analysis of behaviour associated with appropriate, as well as, inappropriate thinking and eating habits. The obese tend to overeat in certain situations which if controlled may help towards keeping the weight in check. Keeping a food diary, the act itself is associated with weight loss. This means that if an individual pays attention to when and what he/she eats, they tend to eat less. It should not be inferred from here that behaviour therapy avoids the need for restricting energy intake. That still remains the mainstay of the treatment. The individual must learn to correct the negative thoughts that accompany a dietary lapse, e.g., instead of thinking that 'I have wasted all my efforts, I ate a piece of cake today', they should think 'One slice of cake is not going to increase my weight'. This shift of thought process helps tremendously in continuing the effort to lose weight. The following strategies related to lifestyle modifications are helpful. You may advocate these to obese individuals.

Remember:

- Have regular mealtimes. Irregular eating habits put a lot of strain on the body.
- Do not read or watch television while eating, you will land up eating more than you do otherwise.
- Try to keep healthy snacks at home like fruits, vegetables and sprouts instead of biscuits, cakes, fried snacks and other fast foods.
- Do not keep nibbling between meals. You will benefit by planning three main meals with one mid-morning and an evening snack.
- Eat slowly, chewing the food properly.
- Serve smaller portions so that another helping can be taken.
- Avoid drinking of alcohol and smoking.
- Incorporate some amount of exercise in your daily routine.
- Handle stress in a positive manner through exercise, yoga and meditation.

Having looked at the dietary management, physical activity and lifestyle modification next, let us briefly review the pharmaceutical and surgical management of obesity.

9.5.2 Pharmaceutical Management

A person with BMI 30 and above may require pharmaceutical management in addition to dietary and lifestyle modifications. It may also need to be considered when the obese person has associated problems such as impaired glucose tolerance, dyslipidaemia and hypertension. Complications like severe osteoarthritis, obstructive sleep dyspnoea etc. may also necessitate use of drugs. Let us get to know about these drug.

Anti-obesity Drugs: The anti-obesity drugs can be classified into two broad groups as indicated in the Figure 9.5.

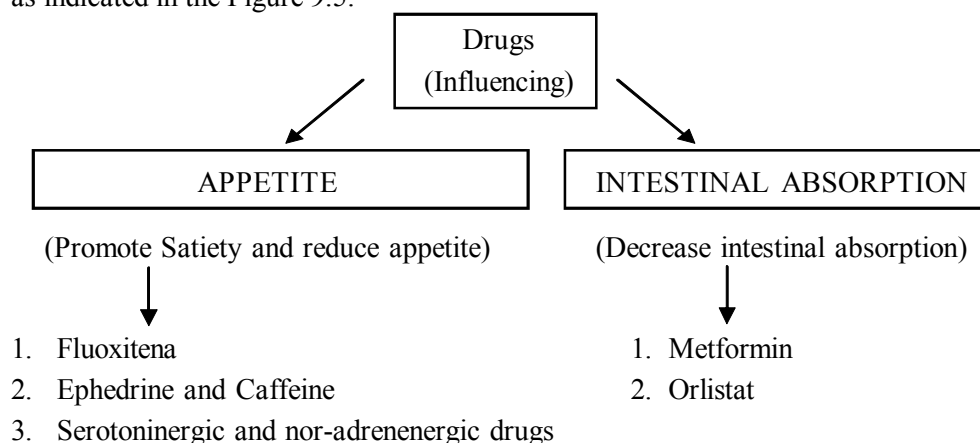


Figure 9.5: Anti-obesity drugs

Drugs must be taken only under Doctor's advice as some can lead to side effects such as cardiac and liver problems. Herbal preparations must not be used as they lack clinical evidence. Laxatives and diuretics are ineffective and liberal use of these can affect the water and electrolyte balance of the patients body.

Caution should be practised in giving antiobesity drugs to patients undergoing psychiatric treatment or those having any drug allergy. Their use is contraindicated for children and pregnant and lactating women.

9.5.3 Surgical Management

Surgical procedures are generally restricted for the morbidly obese persons. If an individual has a BMI of 40 or higher, or a BMI of 35 or higher with associated comorbidities he/she may benefit by one of the surgical procedures. This specialized area is known as Bariatric Surgery and includes the following procedures :

- a) Gastric restrictive surgery
- b) Jejunioleal Bypass
- c) Jaw Wiring
- d) Liposuction

Post-operative evaluation by the team of surgeons, dietician and psychologist at regular intervals throughout life is of prime importance. Let us review the procedures.

- *Gastric Bypass Surgery* is the current 'gold standard' for bariatric surgical procedures. It involves use of a stapling device to create a tiny stomach 'pouch' by partitioning the stomach near its upper end to reduce the capacity of the stomach. On an average, the patient loses 30-40% of weight by this procedure.

The stomach size can also be reduced by using stainless steel staples across the upper portion of the stomach. Only about 1 cm opening is left into the distal stomach. This method is known as gastropasty. This is found to be quite successful.

- *Jejuno-ileal Bypass*: Absorptive surface of the small intestines can also be reduced through surgery called the jejuno-ileal by pass. Some complications may arise by this method.
- *Jaw Wiring*: Wiring the jaws closed has been effective in reducing weight because wiring permits the intake of only liquid that can be taken through a straw. Liquids and supplements that will provide adequate nutrition are given.
- *Liposuction*: Liposuction is a cosmetic surgical procedure different from bariatric surgery. It involves aspiration of subcutaneous fat using thin cannulas inserted through very small incisions. The cannulas are attached to a high vacuum source and fat is aspirated with a collection device. Contour is diminished as the overlying skin shrinks to the reduced fat volume. Only 5 lb. of fat can be removed at a time.

You have learnt how surgical methods are used in case of morbid obesity. Once the treatment is done maintenance of appropriate weight is of prime importance. Let us see how this can be done. The preventive aspects are discussed next.

9.5.4 Preventive Aspects

Maintenance of Weight Loss: Once an individual has managed to lose weight to a desirable level, it must not be assumed that the weight loss will be maintained automatically. The person will have to make a conscientious effort to prevent gain in weight. You will recall that energy requirements are reduced after weight is lost. After the intense dietary effort is over and the person reverts to the so called pre-dieting eating pattern, he/she is likely to put all the weight back before equilibrium is re-established.

To avoid this weight cycling, one must add extra food items to the diet only gradually and with extreme caution. The person still needs to avoid high calorie recipes. He/she must keep a record of weight every week. Any extra weight gained during this period, however small, must be lost immediately either by reducing food intake or increasing energy expenditure the following week. The person must not reduce the physical activity once he/she attains the goal.

You must remember that there is a reduction in metabolic rate after weight loss which is also conducive to subsequent weight gain on the same energy diet. To remain at the target weight the person will need to, in fact, reduce energy intake by 10-15% which is the maintenance energy cost of the weight lost.

Prevention in the prevalence of overweight/obesity: It is believed that the increase in prevalence of obesity worldwide is more due to the environment that has become conducive to weight gain rather than genetic mutations within individuals. As pointed out earlier, Asian population is more susceptible to developing co-morbidities even at quite modest weight gains. You must have fully understood by now that obesity is a major risk factor for several chronic degenerative diseases. That is why it is all the more important to employ strategies that aim at creating environments facilitating behavioural changes in general populations regarding diet and physical activity to prevent this enormous public health problem.

The first and most important step for the rapidly progressing developing countries like India is to collect and organize data from various regions about the prevalence of obesity. Once the true prevalence is known, the goals or targets to reduce the same can be set. Let us consider towards whom the prevalence strategies need to be targeted.

The prevention strategies need to be targeted basically at two sub-groups in the population.

- i) Those who are already obese and need advice regarding reducing weight and maintaining it. These persons, if not careful about their diet are liable to gain weight. They need to be guided appropriately regarding a maintenance diet because after a period of controlled eating, they tend to go back to their original diet or favourite foods which may be high in energy and short on important nutrients. All weight reducing clinics/community slimming centers must offer appropriate guidance and support to people who have achieved weight loss successfully to prevent regain in weight.
- ii) Those who are at increased risk of becoming obese and require help to avoid putting on weight. This is the major population group towards which public health measures need to be targeted. It is believed that fitness at the age of 13 years is quite a strong predictor of adult fitness. Children between the age of 7 and 12 years of age, therefore, may be a very important group that falls into this category.

In addition, it is important to develop strategies to prevent the population in general from becoming obese. The major approaches of any public health strategy to reduce obesity shall be firstly, to reduce calorie intake from fat and secondly, to increase the level of physical activity.

How to reduce calorie intake from fat?

- Efforts should be made to increase the nutrition knowledge of the general public through mass media.
- The foods with lower fat content should be made easily available and popularized.
- People should be motivated to make healthier food choices, especially when eating out.
- Sincere efforts should be made by health professionals/systems to promote dietary changes.

How to increase the levels of physical activity?

- The benefits of physical fitness should be spread among the public through mass media.
- Physical activity should be encouraged in educational and other institutions.
- Opportunities for physical activity should be provided at work places and industry.
- Public facilities for physical activity and exercise should be increased.

National Approach - An Example

A number of countries have adopted a national approach to deal with the prevention of obesity and other non-communicable diseases. At a symposium on 'Obesity' at the IX Asian Congress of Nutrition, in 2003, Mabel Deurenberg-Yap of National University of Singapore discussed the health promotion strategies to reduce obesity in her small and highly urbanized country, Singapore. Singapore had initiated National Healthy Lifestyle Programmes and School Health Promotion Programmes twenty years ago to promote healthy eating and active life styles with a view to reduce the risk factors associated with lifestyle related non-communicable diseases. Strong governmental support, as well as, consistent effort by the organizers has resulted in reducing obesity rates today, particularly among children. Adults have also been highly motivated to engage in physical activity. The government has developed a number of parks and swimming pools at short distances near residential areas to facilitate participation in aerobic exercises and games. Schools besides classroom teaching have special emphasis on sports and outdoor exercises.

Evaluation of these programmes to reduce obesity is regularly being carried out in order that they may be improved upon and may become more effective. Special emphasis is also given to health promotion research and evaluation. The country has been successful in setting an example which other nations must try to emulate.

Check Your Progress Exercise 3

1. How can one manage obesity? Briefly discuss the dietary guidelines for an obese individual.
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.....
.....
2. Discuss the role of individual counseling in a weight reduction programme.
.....
.....
3. Enumerate the benefits of exercise/physical activity on CVD.
.....
.....
4. What are the two broad categories of antiobesity drugs? For whom are these contraindicated?
.....
.....

Now that we are well versed with obesity and its medical nutrition therapy, we move on to underweight the other weight management issue.

9.6 UNDERWEIGHT

Just as overweight is the result of a positive energy balance irrespective of the etiology, underweight results when the energy balance is negative. Failure to consume sufficient calories to meet the energy requirement of the body for whatever reasons is responsible for not maintaining optimum weight. You have learnt that too much deviation on either side from the appropriate body weight increases the risk of health problems. You may also recall reading earlier about the prevalence and classification of underweight in section 9.2 of this unit while we were discussing the prevalence of weight imbalance. In addition, it is relevant to note that as per the report of WHO (1998), an estimated 50 million adult women are classified as being severely underweight in developing countries. It also states that the consequences of poor health in childhood and adolescence including malnutrition, become apparent in adulthood, particularly during the childbearing years.

At the IX Asian Congress of Nutrition (2003), Z.A. Bhutta, Pakistan reported that adult women who suffer from malnutrition had a much higher risk of giving birth to low birth weight (LBW) infants. LBW infants are at a higher risk of mortality. Those who survive are poorly breastfed and weaned, resulting in stunted, malnourished children. Additionally, LBW females developed into malnourished mothers who in turn gave birth to LBW infants. He stressed that this cycle could only be broken by optimizing nutrition throughout the life cycle. So then the adverse consequences of underweight are obvious. But, what is the cause for this condition? Let us read the next section and find out.

9.6.1 Etiology

There are a number of factors causing underweight. These are:

- Poor selection of food
- Physical activity
- Mother's health status
- Pathological condition
- Genetic predisposition

Let us learn a little about each of these factors.

- *Poor Selection of Food:* Poor selection of food along with irregular eating habits may be responsible for insufficient food intake and hence calorie intake. It may be due to ignorance or a lack of purchasing power of the family.
- *Physical Activity and Psychological Factor:* Individuals who are tense, nervous and extremely active and who do not rest sufficiently tend to expend more energy than what they are able to eat. This can cause undernutrition.
- *Mother's Health Status:* Poor nutritional status of the girl child coupled with under nutrition during pregnancy results in LBW infant being born. These children born are at a disadvantage right from infancy and may fail to reach optimum weight in adulthood.
- *Pathologic Conditions:* Illness can affect weight status in a number of ways. For example, fevers and infections, increase the demand for energy, which if not met because of poor appetite, lead to loss of weight. Food intake may be severely limited by nausea, vomiting or diarrhoea in gastrointestinal disturbances. Metabolic rate may be greatly increased in hyperthyroidism resulting in underweight. Drug therapy may also alter taste or reduce appetite, leading to weight loss.
- *Genetic Predisposition:* As explained in section 9.2 of this unit, the weight of an individual is inherited basically from his biological mother. In the event of the biological mother being thin, there is 75% likelihood of the individual being thin also.

Next, let us review the metabolic aberrations and clinical manifestations linked with underweight.

9.6.2 Metabolic Aberrations and Clinical Manifestations

Metabolic Aberrations: When energy intake falls below the minimal requirements, the body responds with an orderly physiologic adaptation involving the hormones of energy metabolism. This causes mobilization of free fatty acids from adipose tissues and of amino acids from muscle to provide energy. Protein synthesis is cut down because proteins are burnt up for providing energy to the body. The metabolic rate of the body is reduced and lean body mass and adipose tissue contract resulting in weight loss.

Undernutrition is generally accompanied by protein deficiency in the body. Fortunately, the condition is reversible with proper nutritional support.

Changes in Body Tissue Compartments: The severity of nutritional deprivation determines the extent of changes in the body tissue compartments. The first casualties in moderate undernutrition are mainly the visceral proteins and muscle cell mass without any change in body fat. In severe undernutrition, losses of both muscle cell mass and body fat occur to a significant degree. Anthropometric measures and laboratory determination of protein status can predict the extent of changes in the body tissue compartments.

A number of micronutrient deficiencies may occur in individuals who are underweight because of the less quantity of food ingested. A starving patient has inelastic skin, slow pulse, low blood pressure, marked emaciation and progressive loss of weight.

Clinical Manifestations: Underweight may predispose to fatigue, lethargy and breathlessness. Iron-deficiency anaemia is usually seen because the diet is bound to be deficient in iron at a low intake of food. The accompanying protein deficiency, if severe, may manifest itself in the form of oedema. Underweight individuals are likely to suffer repeatedly from infection because of low immunity. Hip fracture is often preceded by weight loss. Metabolic aberrations occur during starvation and these may cause bradycardia (slow pulse), hypotension (low blood pressure), constipation, dry skin and hair, abnormalities of nervous system, depression and ultimately death.

So what can we do to prevent these manifestations. The dietary management is highlighted next.

9.6.3 Dietary Management

We just read about the etiological factors that may lead to undernutrition and weight loss. Whatever may be the cause, all underweight individuals are usually in a negative energy balance and have depleted reserves of most nutrients. The diet prescribed for effecting weight gain should be high in calories, proteins, fat and carbohydrates. Since the capacity of the intestines to digest and absorb food is considerably reduced with undernutrition, the addition of foods above the usual intake has to be slow and gradual. We shall now discuss some of the salient features of a weight gain diet for individuals not suffering from any form of chronic disease that requires restrictions in the nutrient intake. So, let us start with the calorie intake which is most significant to weight gain.

Energy: The total calorie intake should be 500 to 1000 Kcal in excess of the daily needs in order to result a gain in weight by half to one kilogram in a week. Thus, if you need 2000 Kcal for your normal activity, you require 2500-3000 Kcal per day for weight gain. We can also compute the energy requirements on the basis of ideal body weight (as discussed in subsection 9.5.1 of this unit). The patient may be given 30-35 Kcal per Kg ideal body weight per day. The calories should be increased gradually over a period of one or two weeks to avoid digestive disturbances.

Proteins: Proteins are required for tissue building, as well as, to take care of the daily wear and tear. Under weight individuals generally have depleted lean body mass and poor reserves of amino acids/blood proteins. Thus, the patient may benefit by consuming around 1.2 g per kg body weight of proteins per day. A combination of both animal and plant proteins should be incorporated but emphasis should be laid on the inclusion of easy to digest forms of protein such as half boiled egg, steamed/boiled/sautéed flesh food etc.

Fats: We know that fats are concentrated source of energy (1g = 9 Kcals). Fats are capable of increasing the energy value of the diet without adding much bulk to it. Add extra fat gradually, a sudden increase in fatty foods like butter, cream and oil may produce diarrhoea. About 30% of calories should come from unsaturated sources of fat.

Carbohydrates: Liberal amounts of easy to digest carbohydrates should be included in the diet. The intake of dietary fibre should be minimized so as to prepare meals which are nutrient dense and have a small volume. Include more of high calorie vegetable like potatoes, colocasia and yam instead of raddish, cucumber, leafy vegetables which are low in the carbohydrate content. All cereals provide high calories at low cost. Carbohydrates should provide about 60-65% of total kilocalories.

Vitamins and Minerals: If the diet provides good amounts of fresh fruits and vegetables, vitamin or mineral supplements are usually not required. However, if the patient indicates clinical signs of a severe nutritional deficiency, it may be imperative to use supplements or employ other essential medical measures.

Fluids: Take fluids only after a meal instead of with or before meals so that food intake is not reduced. High calorie nourishing beverages such as milk shakes, egg nog should be preferred over low nutrient beverages such as cold-drinks, barley water, plain soda etc.

Planning the Daily Diet

As mentioned above you need to add calories gradually to the diet. A practical way of doing so is to take the present intake of the patient and to improve upon it both qualitatively and quantitatively day by day till you reach the prescribed level. Try to add foods from most of the food groups. You can add 500 Kcal to the diet by including any of the following combinations

Whole milk	: 1glass (250ml)
Boiled egg	: one
Bread	: one slice
Banana	: one
	OR
Chapatties	: 2
Dal	: 1 bowl (30 g raw)
Cottage cheese	: 40 g
Sapota	: One
	OR
Fried Rice	: 1 bowl (30 g raw)
Curd(whole milk)	: 1 bowl (100 g)
Ice cream with fruits	: 1 cup

The patient should be advised to take small, frequent, easy to digest meals. As the person improves in weight without having any gastrointestinal problems, he/she could take calorie-rich foods. You will learn how to select high calorie foods and plan diets

for ambulatory and hospitalized patients to promote weight gain in the Practical Manual (MFNL-005).

SELECT CALORIE-RICH FOODS. INCREASE THE SERVINGS OF FOODS GRADUALLY. EAT FREQUENTLY. ENJOY THE FOODS YOU LIKE IN A HAPPY ENVIRONMENT.

The subject of weight management is vast and has unending diverse applications in the management of individuals with/without an underlying disease condition. We end our discussion here within the parameters of this unit but strongly recommend additional reading to clear your views on various food fads and misbeliefs. Let us now attempt the questions mentioned in check your progress exercise 4 to recapitulate the contents of this section.

Check Your Progress Exercise 4

1. Fill in the blanks:
 - a) A BMI value of less than denotes underweight.
 - b) Protein deficiency is when proper nutritional support is provided to underweight individuals.
 - c) A starving patient haspulse and.....blood pressure.
 - d) Malnutrition in adult women can be a risk factor for birth of..... infants.
 - e) 1 gram fat provides Kcal of energy.
2. List three pathological conditions that may contribute to underweight.
.....
.....
.....
3. How can you add 500 Kcals to the diet of an underweight individual? Give one example.
.....
.....
.....

9.7 LET US SUM UP

It must have been an interesting unit to read because we all are interested in maintaining an ideal body weight and also because this topic has a wide applied aspect. For this reason; we have also designed a partical (Manual-005) for you to learn the use/planning of diet(s) based upon maintenance of an optimum body weight espealy with respect to various diseases.

In this unit we learnt about weight imbalance and the difference between different grades of under/excess body weight. The metabolic and clinical manifestations of both under and overweight were also discussed (impaired glucose tolerance, hyperinsulinemia, insulin resistance, hyper-lipidemia etc.). In the section 8.5 you must have learnt about the dietary and life-style management for over weight/underweight individuals. Read this carefully as the fundamentals of these are utilized for effective and accurate planning of diet(s) for such individuals with or without a disease (diabetes, coronary artery disease(s), cancer; gout; fever etc.). The physiological effects of increased physical activity were also briefed in this unit. Nutrition supports and non-

dietary (surgical, pharmaceutical), measures with respect to weight management are gaining in roads for the treatment of secure obesity and a dietician's help is often required for ensuring optimum nutritional care of the patient. Reading this unit must have helped you in gaining an insight/better understanding on the various aspects of weight management.

9.8 GLOSSARY

Arthritis	: a disease that involves an inflammation of a joint or joints.
Bariatric Surgery	: surgical procedures for treatment of obesity.
Bariatrics	: a scientific study of obesity and its related disorders.
Binge eating	: an episode of excessive eating accompanied by a sense of loss of control over the eating process.
Borborygmi	: abdominal gurgles due to movement of excessive fluid and gas in the intestines.
Brown Fat	: a dark-coloured, mitochondrion-rich adipose tissue in many mammals that generates heat to regulate body temperature.
Carotenemia	: presence in the blood of yellow pigment carotene from excessive intake of carotene rich vegetables and fruits.
Comorbidity	: any condition that worsens as the degree of obesity increases and improves as obesity is successfully treated.
Cushing's syndrome	: a glandular disorder caused by excessive steroid hormone resulting in greater than normal functioning of adrenal gland; characterized by obesity.
Hirsutism	: an excessive growth of coarse hair particularly in women.
Hypercholesterolaemia	: elevated blood cholesterol levels.
Hyperplasia	: an increase in tissue size by an increase in number of cells.
Hypertriglyceridaemia	: elevated level of serum triglycerides.
Hypertrophy	: an increase in tissue size by an increase in cell size.
Hyperuricaemia	: elevated serum uric acid levels.
Life expectancy	: a statistical measure of the average of the remaining life time of an individual in the given group.
Lipogenesis	: fat formation.
Liposuction	: the removal of excess body fat by suction with specialized surgical equipment.
Morbidly obese	: patient's who are 0-100 % above their ideal body weight; a BMI value greater than 39.
Obesity	: a condition describing excess body weight in the form of fat.

Osteopaenia	: a decrease in the bony mass due to a decreased rate of osteoid (organic matrix bone) synthesis.
Osteoporosis	: loss of bony tissue resulting in bones that are brittle and liable to fracture.
Overweight	: being too heavy for one's height; a BMI of 25 to 30 kg/m ²
Quality of life	: the level of well being of life style and the physical conditions in which people live.
Resting Metabolic Rate:	the minimum number of calories needed by the body to support its basic physiologic functions.
Syndrome X	: a condition associated with glucose intolerance, insulin resistance, hyperlipidemia and hypertension, strongly linked to fat accumulation in the intra-abdominal cavity.

9.9 ANSWERES TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress Exercise 1

- 200, 338
 - 5
 - 64.5 and 30.5
 - upper middle
 - 1.0, 0.85
- A person can be categorized to be overweight /obese by computing the body mass index or the waist hip ratio.

Body Mass Index (BMI) is calculated as:

$$\text{BMI} = \frac{\text{Weight (in kg)}}{\text{Height (in meters)}^2}$$

- A body mass index greater than 25 is indicating of over weight/obesity.

Waist hip ratio i.e.
$$\frac{\text{Waist circumference (cm)}}{\text{Hip circumference (cm)}}$$

WHR of >1.0 for men and >0.85 for women is an indicator of abdominal obesity.

- Age, sex and height are the three essential factors that determine an individual's ideal body weight.
- b)
 - a)
 - d)
 - c)
 - e)

Check Your Progress Exercise 2

1.
 - a) False. When people are offered a variety of foods, their intake is likely to be more than when a single food is available.
 - b) True
 - c) True
 - d) True
 - e) False. Obesity predisposes to hyperinsulinemia and increased glucagon levels
 - f) False. Energy expended in physical activity is 15-30% of total energy expenditure.
 - g) False. Resting Metabolic Rate is regulated by the β_3 adrenoreceptor gene in human beings
2. Obesity is a physiological condition resulting from accumulation of excess adipose tissue i.e. body fat. The etiological factors are: genetic susceptibility, dietary habits, reduced physical activity, increasing affluence and abundant availability of food, psychological factors, hormonal imbalance, high birth weight and childhood growth pattern.
3.
 - a) Firstly, as the quantity of food ingested is increased, thermogenic effect of food would also increase amounting to about 10% of the excess intake. Secondly, the energy stored would increase both the fat and the fat-free mass resulting in an increase in metabolic rate. This adaptation of metabolic rate which tends to oppose fluctuation in weight does not permit weight gain in direct proportion to increase in calorie intake.
 - b) Initially, glycogen stores are mobilized which is accompanied by a corresponding loss of water. Then, as weight is lost, it results in loss of extra muscle which was developed to support the extra adipose tissue. Loss of lean body mass reduces the RMR rapidly so that on a given diet, the energy deficit is reduced and the rate of weight loss slows down.
 - c) WAT is an endocrine organ, which besides some other factors secretes a hormone leptin. Leptin seems to have a role to play in reducing appetite or increasing satiety and also in regulation of the energy balance.
4. Metabolic aberration seen are deranged lipid profile insulin resistance, hyperinsulinaemia etc. Read subsection 9.4.3 and write brief account for each in your own language.
5. The fatal risk factors for obesity include: cardiovascular disease, diabetes mellitus, cancer, syndrome X, arthritis and gout. Some non-fatal conditions like back pain, infertility, sleep disorders and respiratory conditions may also be seen.

Check Your Progress Exercise 3

1. The management of obesity basically comprises of the three-pronged approach. These are: dietary modifications, physical activity, and behaviour and lifestyle modifications.

Dietary guidelines for an obese include 1g protein per kg body weight. About 25% or less of total calories should come from fat. About 50-55% of total calories may be from complex carbohydrates, mostly plant-based. Vitamin supplements should be given in case of long duration calorie restriction. A diet high in sodium may promote retention of fluid in the body. Liberal amounts of fluid may be included in the diet if salt is restricted.

2. Individual counseling is of prime importance because that is required to establish realistic goals for the treatment. It is also important to take the dietary history of the patient and to know about his food habits and pattern of living for prescribing an adaptable diet schedule.
3. The benefits of exercising are that it reduces blood pressure, decreases harmful body fats, increases HDL cholesterol, help in increasing bone density, reduces risk of all types of cancers significantly and increases longevity.
4. Two types of anti-obesity drugs are (i) appetite suppressants, and (ii) intestinal absorption suppressants. These drugs are contraindicated for children, pregnant and lactating women and patients who have had adverse effects from such drugs in the past.

Check Your Progress Exercise 4

1.
 - a) 18.5
 - b) reversible
 - c) slow, low
 - d) LBW
 - e) 9
2. The three pathological conditions that can contribute to underweight include, recurrent infection, fever, chronic diarrhoea/ulcers, degenerative diseases such as cancer.
3. Answer on your own. Look up sub-section 9.6.3 for reference.