

NUTRITIONAL STATUS : ITS ASSESSMENT

26.1 INTRODUCTION

You have already learnt in lesson 22 that good nutrition is the basis of good health. You know that a balanced diet is of utmost importance in achieving normal growth and development. You must have seen people who eat food according to their body needs, they grow well and are healthy. However, some people eat either too less or much more than what their body requires. Such people are either very thin and weak or, fat and obese.

Have you ever thought whether you are in a state of good health and nutrition or not ? It is simple and you can find it out yourself.

In this unit, you will read about the different methods which help to assess the nutritional status of any individuals.

26.2 OBJECTIVES

After reading this lesson, you will be able to :

- define nutritional status and nutritional assessment;
- enlist and describe various methods of assessing the nutritional status;
- state merits and limitations of each method;

26.3 NUTRITIONAL STATUS AND NUTRITIONAL ASSESSMENT

You have already read that the state of health of an individual is affected by the intake and utilization of nutrients. It is called the nutritional status. Can you define it ? Nutritional status is therefore, 'a condition of

intake and utilisation of nutrients which is manifested in good or bad health'.

Following figure shows the forms of nutritional status.

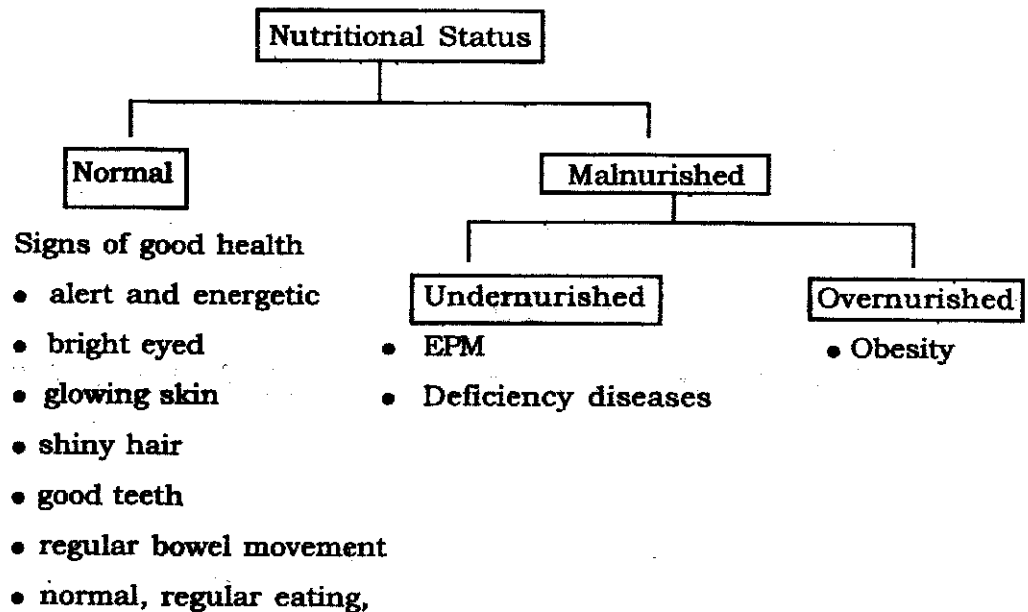


Figure 26.1 Classification/forms of Nutritional Status.

You may already be asking yourself if you have a normal nutritional status. From the figure you have some points on which you are probably trying to decide if you are normal or malnourished. Generally, thick and silky hair, bright eyes, normal skin and good teeth are signs of good health. Similarly, adequate food intake and regular bowel habits indicate the state of normal nutrition. Symptoms contrary to these are associated with malnutrition. In this process of saying whether you are healthy or malnourished you are actually making an assessment of your food intake and utilisation of nutrients in your body. *"Nutritional assessment, therefore can be defined as a definite value judgement of the quality and quantity of the intake and utilisation of nutrients."*

Methods of assessment of nutritional status : Nutritional status of an individual can be systematically assessed by adopting four standard methods. These are as follows :

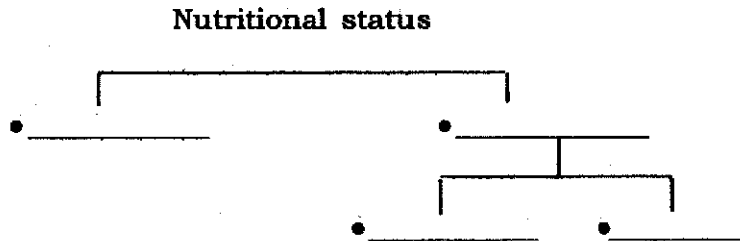
- (a) Anthropometric measurements
- (b) Biochemical tests
- (c) Clinical examination
- (d) Dietary survey

Have you noticed that there is a link, between the first letter of each of the methods ? You can remember these methods as 'ABCD'. You should

know that each of these methods is equally important and has a unique role in assessment of the nutritional status. While assessing nutritional status you should adopt all the four methods.

INTEXT QUESTIONS 26.1

1. Define nutritional assessment and nutritional status
2. List characteristics of normal nutritional status.
3. Complete the following chart



4. List methods of nutritional Assessment.

26.4 ANTHROPOMETRIC MEASUREMENTS

You know that physical growth takes place in a young child till s/he becomes an adult. This growth is dependent on the nutritional intake of the child. If the child eats well, the growth is normal. But if certain nutrients are constantly lacking in his daily diet, it leads to nutritional deficiencies and poor physical growth—low weight, short height, smaller size of the head and chest. Thus, by measuring size and shape and comparing these to the normal, weight, height, etc. you can assess the nutritional status of a child by comparing actual measurements with those of normal healthy child.

The measurements relating to assessment of different areas of the body are called anthropometric measurements.

Most commonly used measurements are :

- (i) Weight
- (ii) Height
- (iii) Circumferences
 - Mid upper arm
 - Head
 - Chest

You will now read about the technique and site of measuring each of the above anthropometric measurements.

(i) **Weight** : You must have seen the health workers doing health check-up of children in your area. What does she do ? The first thing she does is to weigh each child. Do you know why she weighs all the children ? Yes. You have already learnt in lesson 22 that every child's body weight must tally with the body weight of other normal children of his age. This also mean that for any age there are weight norms and all healthy normal children of that age group must have that or similar weight. This is called *weight for age* weight norms.

Reference weight norm is the body weight which most normal children of that age have. Tables have also been provided for you to know whether the weight of the child is normal or not.

Once you know the body weight of a child you can refer to the weight norm table. This will help you to comment on the nutrition status of the child.

Taking weight and interpreting it in terms of age is called 'weight for age.'

You know when a child is healthy and has a normal physical growth, the body weight increases regularly with increase in age. However, if the child falls sick, i.e. has fever, or diarrhoea or an infection for a few days, there is sudden weight loss. Figure 26.2 depicts a graphic representation of states of normal nutrition and malnutrition based on weight for age.

LENGTH (cm.)	BOYS (kg)	GIRLS (kg)	LENGTH (cm.)	BOYS (kg)	GIRLS (kg)	LENGTH (cm.)	BOYS (kg)	GIRLS (kg)
50	3.3	3.4	67	7.7	7.5	84	11.7	11.4
51	3.5	3.5	68	8	7.8	85	11.9	11.6
52	3.7	3.7	69	8.3	8.1	86	12.1	11.8
53	3.9	3.9	70	8.5	8.4	87	12.3	11.9
54	4.1	4.1	71	8.8	8.6	88	12.5	12.2
55	4.3	4.3	72	9.1	8.9	89	12.8	12.4
56	4.6	4.5	73	9.3	9.1	90	13	12.6
57	4.8	4.8	74	9.6	9.4	91	13.2	12.8
58	5.1	5	75	9.8	9.6	92	13.4	13
59	5.4	5.3	76	10	9.8	93	13.7	13.3
60	5.7	5.5	77	10.3	10.0	94	13.9	13.4
61	5.9	5.8	78	10.5	10.2	95	14.1	13.6
62	6.2	6.1	79	10.7	10.4	96	14.4	14
63	6.5	6.4	80	10.9	10.7	97	14.7	14.3
64	6.8	6.7	81	11.1	10.8	98	14.9	14.6
65	7.1	7	82	11.3	11	99	15.2	14.9
66	7.4	7.3	83	11.5	11.2	100	15.5	15.2

Fig 26.2 Reference table (height for weight)

You can observe significant changes in weight within a period of few days. Thus, weight for age is considered to be a sensitive indicator in measuring acute state of malnutrition which occurs during a short-duration.

After knowing the importance of weight in determining the nutritional status of an individual, let us now learn the technique of measuring weight. It is simple. You can measure weight with the help of various types of weighing scales.

You must prefer lever balances for correct recording of body weights. However, spring balances are easily available and thus used more widely.

Technique :

- (i) Take a weighing scale. Keep it on a flat platform.
- (ii) Ask the individual to stand bare-feet at the centre of the weighing scale, with minimum clothes worn.
- (iii) Weigh when the individual is breathing normally. Avoid recording weight if the individual breathes deeply or cries.
- (iv) Record the body weight kilograms to the last decimal unit.

This technique is used to weigh older children and adults .

In case you have to weigh an infant below 2 years of age, then what will you do ? You can use the same weighing scale but the procedure will be as follows :

- (i) The mother, along with the child in her arms, is made to stand on the weighing scale. The reading is taken.
- (ii) The mother alone is weighed next.
- (iii) Reading (ii) is subtracted from reading (i). The difference of the two readings gives the weight of the infant child.

Now-a-days in health centres, Salter scales are being used for measuring weights of young children. The technique is :

- (i) The salter scale is hung freely from a tree or a hook.
- (ii) The child is placed in the sling and the digital dial of the scale shows the weight of the child.

Activity : Take weights of 5 children in your area using a weighing scale. Compare the weight of each child with the reference table. (PAGE 3, BOOK 3) Comment on nutritional status of these children.

S.No.	Age of child	Weight of child	Reference weight	Comment
1.				
2.				
3.				
4.				
5.				

(ii) Height :

Like weight, height of a child also increases with age. However, unlike weight, the change in height is relatively slow. Even when there is undernutrition, height never decreases. In case of severe undernutrition, there will be either no increase in height or only a marginal increase.

Then, how is height important to determine the nutritional status ?

Height is equally important as weight in assessing the nutritional status of an individual. At a given age, a child is expected to have attained a particular height. This is called height for age. Like weight, we have norms for height as well. You have already learnt about it in lesson 22. You can compare the heights of the children at different ages with these reference tables and comment on their nutritional status.

Measuring height and interpreting it in relation to age is known as 'height for age'.

When a child is deprived of good nutrition, physical growth is affected. This is indicated not only by loss in weight but also by slow or no increase in height over a period of time. Since the effect of undernutrition on height is observed after a long period, height for age helps to detect chronic state of malnutrition.

Do you know how to measure height ? You can easily measure height of people by following the steps given below.

You can either use a heightmetre or you can fix a flexible, non-stretchable steel measuring tape on a straight wall to measure height.

Technique:

- (i) Ask the individual to stand straight and barefeet on the floor or a platform against the wall.
- (ii) The feet should be parallel with heels, buttocks, shoulders and back of the head touching the wall.
- (iii) The head should be erect with the eyes looking straight in front.
- (iv) A flat horizontal object is then moved downwards till it touches the top of the head.
- (v) Take the reading on the measuring scale against this level. The reading should be taken in cms upto the last decimal unit.

This technique is adopted when you have to measure height of older children and adults.

Instead of height, you measure length in infants. The linear measurement taken from the head to heel of an infant in lying down position is called length. An infantometre is used to measure length. This instrument has a wooden or plastic scale on which the infant is made to lie down in such a position that the head touches the fixed head piece. The legs are pressed fully on the knees and the movable sliding piece is allowed to touch the soles of the feet. The measurement on the scale is recorded to the last decimal unit.

Activity : Measure heights of 10 children from different age-groups. Compare the height of each child with the reference table. Comment on the nutritional status of children.

S.No.	Age of child	Height of child	Reference height	Comment
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

Weight for Height :

You have just read about 'weight for age' and 'height for age' as the indicators of nutritional status. You will observe that 'age' is the common factor in both the above indicators. It is extremely difficult to get the correct age of individuals. You will particularly find this problem among illiterate groups. Such people don't know their date of birth. How do you assess the nutritional status of such individuals ?

This problem is solved by using 'weight for height' as the indicator of nutritional status. In this, you have to measure weight and height of the individual. The principle behind this indicator is that as weight and height increase with age, an individual should have attained a particular weight to be designated as normal. If the individual fails to attain this weight, he/she is considered as undernourished. You can refer to Table 2b.1 for the reference weight for height.

Activity : Visit a nearby school. Measure weight and height of at least 5 children studying in classes I to V. Use Reference Table 2b.1 to compare your data. Comment on their nutritional status.

S.No.	Weight of child	Height of child	Reference weight	Comment
1.				
2.				
3.				
4.				
5.				

(iii) Circumferences :

Roundness of the body also gives an idea about whether the individual is healthy or not. *The measurements of roundness of different areas of the body are known as circumferences.* Different areas of the body used for studying circumferences are, fingers, wrist, forearm, upper arm, chest, waist and leg. Most commonly used sites for measuring circumferences are :

- Mid-upper arm
- Head
- Chest

Do you know what type of tapes are used for measuring circumferences ?

Flexible, non-stretchable measuring tapes are used to take measurements. You will now read about the importance and significance of these measurements.

(a) Mid-upper Arm Circumference (MUAC)

Observe the roundness of upper arm of a few young children of same age around you. It should be same for all. But if it is not; can you guess the reason ? Yes, you are right, the difference is due to variation in nutritional status. Actually, healthy and well-nourished children have well round upper arms. However, the children who consume inadequate diet, have thinner upper arms with loose and wrinkled skin.

Do you know, why poor dietary intake leads to thin upper arms and wrinkled skin ? Nutrients stored under the skin in healthy children provide roundness of MUAC. Inadequate diet leads to depletion of stores leading to loosening and wrinkling of skin. This phenomenon is not restricted to upper arms alone, it can happen in other parts of your body.

Thus, you can assess nutritional status of individuals, particularly young children, with the help of MUAC. Now, how will you measure MUAC ?

Technique :

(i) Take the measurement of the left upper arm at its mid-point.

In case the individual is a left-hander, measurement is taken on right upper arm.

(ii) The arm is allowed to hang freely and the measuring tape is placed around the middle portion of the left upper arm.

(iii) Reading is recorded upto the last decimal unit in cms.

MUAC is most helpful in assessing nutritional status of children below 5 years of age. If the MUAC value is less than 13.5 cm, it will indicate protein energy malnutrition (PEM).

Activity : Measure MUAC of 10 children below 5 years of age. Comment on their nutritional status.

S.No.	MUAC of child	Comment
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

(b) HEAD CIRCUMFERENCE AND CHEST CIRCUMFERENCE :

You must have noticed that when a child is born, the head is larger than the chest. As the child grows, head becomes proportionately smaller to the chest. If head circumference remains more than the circumference of chest beyond 1 year of age, it indicates protein energy malnutrition. These measurements are useful for assessing nutritional status of young children. Following example will help you to understand it.

Example : Four children who are above 2 years of age have following measurements :

<i>Head circumference</i>	<i>Chest circumference</i>	<i>Nutritional status</i>
50 cms	52 cms	Normal
51 cms	48 cms	Undernourished
49 cms	50 cms	Normal
52 cms	50 cms	Undernourished

You can measure circumferences of head and chest in the same way as mid-upper arm. Measure the roundness of head covering the forehead in front and maximum area at the back.

Chest circumference is measured at the level of nipples. You must avoid taking measurement when the child is crying, screaming or breathing irregularly. Can you guess why? While crying, screaming or deep breathing the chest is stretched outside and the measurement will be more.

Activity : Select five children between 1-5 years of age. Measure their head and chest circumferences. Comment on the nutritional status of these children

S.No.	Head circumference	Chest circumference	Comments
1.			
2.			
3.			
4.			
5.			

INTEXT QUESTIONS 26.2

1. Define (i) anthropometric measurements (ii) Weight ~~for~~ age (iii) Weight ~~for~~ height
2. Enlist the commonly used anthropometric measurements in determining nutritional status of individuals.
3. Fill in the blanks :
 - (i) _____ indicates short duration malnutrition.
 - (ii) _____ indicates chronic state of malnutrition.
 - (iii) When age is unknown, _____ is used as an indicator of nutritional status.
 - (iv) A MUAC measurement of less than _____ indicates malnutrition. MUAC measurement should be taken on _____ arm for right handers and _____ arm for left handers.
 - (v) _____ is larger than the _____ at 2 years of age.
4. (i) Most satisfactory balance for correct recording of weight is :
 - a) beam balance
 - b) lever balance
 - c) spring balance
 - d) none of these
 (ii) Infants below 2 years are best weighed :
 - a) on beam balance
 - b) on lever balance
 - c) on spring balance
 - d) in mother's arms

- (iii) Salter scale which is used to measure young children is :
- a) placed on a flat surface
 - b) placed against a wall
 - c) hung from a tree
 - d) hung against a wall
- (iv) When a child is malnourished, circumference of head :
- a) is smaller than chest
 - b) is larger than chest
 - c) is equal to chest
 - d) has no relationship with that of chest
- (v) The circumference of head is measured at the :
- a) base of the head
 - b) middle of head
 - c) in front of forehead
 - d) anywhere on the head
- (vi) The site for the circumference of the upper arm should be :
- a) at the elbow
 - b) at the shoulder
 - c) in the middle of upper arm
 - d) anywhere on the upper arm.

26.5 BIOCHEMICAL TESTS

Do you remember if any test was conducted when you or a member of your family had high fever? The doctor had asked you to get the blood and urine tested.

Such laboratory tests that are carried out on various tissues to detect the cause of the disease are called Biochemical tests.

Biochemical tests are conducted on tissues like liver, kidney, blood, urine, stool, hair and bone. Mostly blood and urine samples are taken. These tests help in the assessment of nutritional status of an individual. Do you know how?

Actually, various nutrients are present in the body fluid. In a healthy individual, the levels of these nutrients are maintained within a normal range. During illness, this normal range gets disturbed, resulting in an abnormal increase or decrease of specific nutrients. Biochemical tests help you to detect either the amounts of nutrients or metabolic products of these nutrients. Thus, such laboratory tests indicate the state of nutrition in the body.

You have already learnt about the role of haemoglobin (hb) in imparting red colour to the blood. In adult males, for example, the normal hb value is 13g per 100 ml of blood. If hb level falls below this point, it indicates iron deficiency in blood, a condition called anaemia. The presence of glucose in urine suggests diabetes.

In this way, many biochemical tests are conducted to diagnose deficiencies or excesses of nutrients in the body. Such tests are mostly accurate and reliable.

However, there are some drawbacks in using the biochemical tests for nutritional assessment :

- It is time consuming procedure.
- It is expensive.
- You require laboratory facilities.
- You require trained and skilled personnel.

Keeping the above demerits in mind, you can decide whether to apply biochemical tests on a large population or not. Remember you can manage the assessment even without these.

26.6 CLINICAL EXAMINATION

You have already learnt in lesson 22 that you can also assess nutritional status of an individual by observing the signs and symptoms of various deficiency diseases.

You have also read about the most common nutritional deficiency diseases and the procedure of recognizing them by observing for the presence of signs and symptoms.

The method of assessing the nutritional status of an individual by examining the clinical signs and symptoms is called clinical examination.

While adopting this method, you have to look for the clinical signs and symptoms from head to toe. You can refer to table 1.2 Nutritional status based on weight for age for the general clinical signs and their nutritional significance.

The merits of this method is that it is simple and quick.

But the major disadvantage of this method is that some of the clinical signs are not specific to a nutritional deficiency and one sign overlaps for more than one deficiency disorder. For these reasons there can be a mistake in identification of the specific problem.

INTEXT QUESTIONS 26.3

1. What are biochemical tests ?
2. What is a clinical examination ?
3. Why do you consider biochemical method of assessing nutritional status better than clinical method ? Give two reasons.
4. Give one reason for choosing clinical examination as method of assessing nutritional status over biochemical method.
5. Fill in the following :

	Merits	Demerits
i) Biochemical Tests	a) _____	a) _____
	b) _____	b) _____
ii) Clinical Examination	a) _____	a) _____
	b) _____	b) _____

26.7 DIETARY SURVEY

You have already learnt in lesson 22 that nutritional status can be assessed by recording dietary intake.

The systematic study of dietary intake of an individual or groups of individuals is termed as dietary survey.

Dietary survey is one of the direct methods of assessment of nutritional status. There are various ways of conducting dietary surveys :

- Twenty-four hour recall
- Weighed intake
- Food frequency
- Food diary
- Dietary history

A combination of all the above methods should be used to assess the dietary intakes of individuals. Let us now read about these methods in detail.

(i) Twenty-four Hour Recall

In lesson 22, you learnt about the steps involved in assessment of nutritional status through dietary intake.

You can convert the amounts of cooked food items in terms of raw food items by using the following formula :

Amount of raw food item eaten (g) =

$$\frac{\text{Amount of cooked food eaten}}{\text{Total amount of food cooked}} \times \text{Amount of raw food items taken for cooking}$$

Twenty-four hour recall method is based on the similar principle of asking the individual to recall the dietary intake in one day. The following questions can be asked :

- What was eaten 24 hours before the interview ?
- How much food was eaten ?
- How was the food prepared ?
- When was the food eaten ?

Once you know amounts of raw food items eaten, you can group them into different food groups. You can then calculate the approximate amounts of foods consumed from each food group.

You can use the following chart to complete your information.

24-hour recall of food intake of an individual

Meal	Menu	Ingredients	Amounts	
			Cooked	Raw
Breakfast				
Lunch				
Evening Tea				
Dinner				
Any other				

Compare the differences in amounts of each food group consumed with the recommended dietary intakes for the age and sex of the individual. When the actual intakes are similar to the recommended dietary intakes, the nutritional status of the individual is considered as normal.

Twenty-four hour recall is probably the most widely used method of dietary survey. But it has certain limitations :

- some people find it difficult to remember everything they ate on the preceding day.
- the day used for recall may not be a typical day of the usual dietary intake. For example, meals are different when friends/relatives visit or when a festival is celebrated or a fast is observed.
- the person may not be entirely truthful.

Activity : Keeping in mind the constraints of 24-hour recall method, use this method to assess the dietary intakes of at least 5 school going children. Comment on their nutritional status. Complete the information on dietary intakes in the following chart :

Stu- dent	Food group	Actual intake of student(g)	Recommended dietary intake (g)	Difference		Comment
				+	-	
I	Cereals Pulses Green leafy vegs.					
II	Cereals Pulses Green leafy vegs.					
III	Cereals Pulses Green leafy vegs.					

(ii) Weighed Intake

In previous method of assessment you were asking the individual to recall what he ate on the previous day. For this method you are actually present when the individual is eating and you weigh the amounts of all food items served as well as the amounts of food not eaten. The difference between the two informs you about the amount of food eaten by the individual. You can use a kitchen weighing scale for this purpose.

Amount of food eaten (g) = Amount of food served (g) — Amount of food not eaten (g)

Weighed intake gives the most accurate picture of the dietary intake. Its limitations are :

- It is time consuming.
- People resist showing what they are eating to the interviewer.

(iii) Food Frequency

As the name suggests, this method consists of asking the individual how often specific food items are eaten. To use this method, you need a

food frequency check-list. This list has two components :

(a) list of different food items

(b) frequency of their consumption (week/fortnight/month)

Based on the format given below, you can prepare a food frequency check-list on your own. You can list down all the common food items available in your area. Once the list is prepared, you can find out the usual food consumption patterns of people around you.

Food frequency check-list

S.No.	Food Item	Frequency of Intake					
		Daily	Weekly	Fortnightly	Monthly	Rarely	Never
I	<i>Cereals</i>						
1.	Bajra						
2.	Jowar						
3.	Maize						
4.	Rice						
5.	Wheat						
6.	Any other						
II	<i>Pulses</i>						
7.	Moong						
8.	Masoor						
9.	Arhar						
10.	Urad						
11.	Channa						
12.	Any other						
III	<i>Green leafy Vegetables</i>						
13.	spinach						
14.	Methi						
15.	Amranthus						
16.	Sarson saag						
17.	Mint						

Food frequency is a quick method to assess the usual consumption patterns of individuals. However, the major disadvantage of this method is :

- that it gives only a qualitative description of dietary intake. It does not give the amounts but only informs about the frequency of intake of different food items.

(iv) Food Diary

Sometimes it is difficult to interview all the individuals in a group regarding their dietary intakes. In such instances, you can ask the individual to maintain a food diary. The individuals fill in all the information about:

- What they eat
- How much they eat
- What time do they eat

A period of 7 days or more can be used to keep a food diary. Once the information is complete, you can determine the dietary intakes of the individuals.

Such records are quite reliable. However, this methods has some limitations :

- Illiterate people cannot keep their food record.
- Some people modify their diets during record keeping period in order to simplify the recording. Hence, it will not give the true picture of the routine food intake.
- Some people are unable to estimate the amounts of food eaten accurately.
- Many people find it a burden to keep the record.

(v) Dietary History

As the term implies, dietary history is a method to record the dietary practices of the individual over a fairly long period of time. Like the food frequency, method, this method too gives only a qualitative estimate of the usual food intake. You can obtain information of the past dietary intake over a period ranging usually between 3 months to a year.

The major disadvantage of this method is :

- Memory lapse. The individuals are unable to remember all what they ate in the past one year.

Thus, you can see that like other methods of nutritional assessment, the method of dietary survey has its inherent advantages and disadvantages. Therefore, you should use this method along with the anthropometric measurements, biochemical tests and clinical examination to obtain correct information about the nutritional status of an individual.

INTEXT QUESTIONS 26.4

1. Define dietary survey.
2. List down different methods of dietary survey :
3. Match the following:

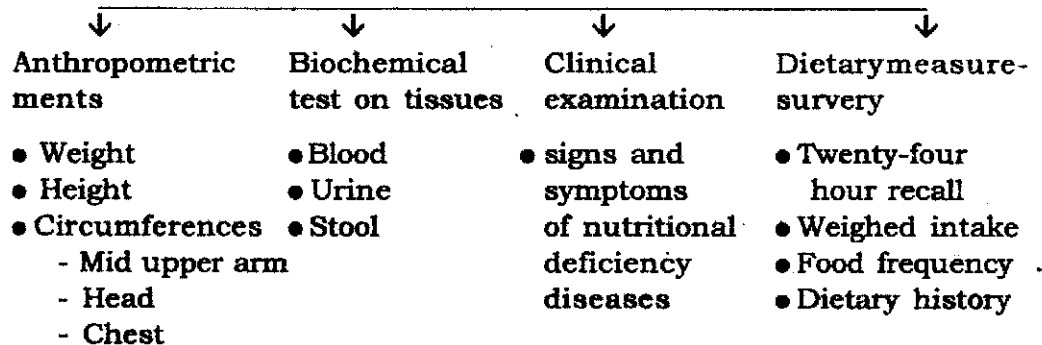
(i) Food frequency	(a) Illiterates cannot use
(ii) Weighed intake	(b) Check-list is used
(iii) Food diary	(c) Recall over a longer period of time
(iv) Twenty-four hour recall	(d) Foods are weighed
(v) Dietary history	(e) Quickest and simplest method

26.8 WHAT HAVE YOUR LEARNT ?

Assessment of Nutritional Status



4 methods used



26.9 TERMINAL QUESTIONS

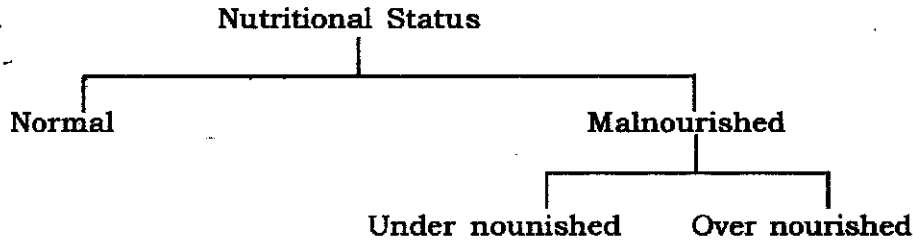
1. Explain the following:
 - (i) Nutritional status
 - (ii) Nutritional assessment
2. Explain the use of weight and height in assessment of nutritional status of an individual.
3. How do the principle of biochemical tests help in determining the nutritional status of an individual.
4. Compare the different methods adopted in dietary survey.

26.10 ANSWERS TO INTEXT QUESTIONS

26.1 1. Refer text

2. Alert and energetic, bright eyed, glowing skin, shiny hair, good teeth, regular bowel movement and normal, regular eating.

3.



4. Anthropometric measurements, biochemical tests, clinical examination, dietary survey.

26.2 1. Refer text

2. Weight, height, MUAC, head circumference, chest circumferences

3. (i) Weight for age

(ii) Height for age

(ii) Weight for height

(iv) 13.5 cm, left upper, right upper

(v) Chest circumference, head circumference

4. (i) Lever Balance

(ii) In mother's arms

(iii) Hung from a tree

(iv) is larger than chest

(v) in front of forehead

(vi) in the middle of upper arm.

26.3 1. Refer text

2. Refer text

3. More accurate and reliable than clinical method

4. It is simpler and quicker than the biochemical method

5. (i) Merits (—) (a) Accurate (b) Reliable

Demerits (—) (a) Expensive (b) require laboratory facilities

(ii) Merits (—) (a) Quick (b) Simple

Demerits (—) (a) non specific signs (b) overlapping of signs

26.4 1. Refer text

2. Twenty-four hour recall, weighed intake, food frequency, food diary, and dietary history

3. b, d, a, e, c