UNIT 8 ASSESSMENT OF NUTRITIONAL STATUS IN COMMUNITY SETTINGS-II

Structure

8.1 INTRODUCTION

In the previous unit, we learnt about different methods of indirect and direct assessment of nutritional status of individuals and communities. We learnt that there are four methods to assess nutritional status under direct assessment. These arc: I) nutritional anthropometry 2) clinical assessment 3) biochemical tests, and 4) dietary assessment. Unit 7 focussed on the various methods used under nutritional anthropometry. We now know that nutritional anthropometry is extensively used for individuals or in communities to assess the extent of malnutrition. Apart from nutritional anthropometry, clinical assessment and biochemical tests are also important. In addition, assessment of dietary intakes of individuals or families provides important information as to the dietary status of community. In this unit, wc would continue our study of nutritional assessment methods by learning about clinical assessment, biochemical tests and dietary assessment as the other three methods of direct assessment of nutritional status.

Objectives

After studying this unit, you will be able to:

- enumerate the methods of direct nutritional assessment namely, clinical assessment, biochemical tests and dietary assessment,
- describe the clinical signs of various nutritional disorders,
- discuss the advantages and limitations in biochemical tests in field surveys,
- explain various methods of dietary assessment, and

plan and implement dietary surveys.

8.2 CLINICAL ASSESSMENT

Clinical examination is one of the common tools used to assess the extent of clinical forms of undernutrition. In the following section, we will discuss about clinical examination and also know about the common clinical signs of various nutrition disorders utilized in nutrition surveys. Before we go into details about clinical signs, we should know that training of the staff assessing clinical signs is very important. Let us find out in detail about the training and standardization procedures.

8.2.1 Training and Standardization

Trained workers only should carry out clinical examination and it should be done in good light. All the investigators should undergo rigorous training so that there is complete agreement in the diagnosis of signs between individuals and between two examinations of a subject by the same investigator. We should record only the presence or absence of a particular sign. Any grading of any clinical sign (like + or ++ etc) should be scrupulously avoided. We should look for the presence of all the signs of commonly occurring nutritional deficiency so that nothing is missed. For the purpose, a schedule/ proforma should be prepared including all the clinical signs to ensure no deficiency sign is missed. You might recall that we studied about clinical signs of various nutritional disorders in Unit 3. Can you recall these signs and symptoms? List these signs/symptoms in the proforma given herewith including all the clinical signs you learnt in Unit 3.

Proforma for reporting nutritional deficiency disorders and **signs and symptoms**

Nutritional deficiency disorders	Signs and symptoms

Are you having trouble in recapitulating all the deficiency signs and symptoms? Well do not panic! Here, in the next section, you will once again find information on clinical signs and symptoms. So review the section below and get back to the proforma later.

8.2.2 Clinical Signs of Nutritional Disorders

What do we mean by clinical signs? *Clinical signs are changes in the body which are indicative of nutritional deficiency/excess. In* this section, we are briefly going to recapitulate the clinical signs of the following nutritional disorders:

- Protein energy malnutrition
- Vitamin A deficiency
- Anaemia
- Goitre
- Fluorosis
- Vitamin C deficiency
- Rickets
- Essential fatty acid deficiency
- Vitamin B coinplex deficiency

Let us begin with protein energy malnutrition.

A. Protein Energy Malnutrition

You are aware that the clinical forms of protein energy malnutrition (PEM) are kwashiorltor, marasmus and marasmic-kwashiorkor. We will now review the clinical signs of these three forms of PEM? You may find this information repetitive, but it is important we recapitulate these clinical signs here. Let us begin with kwashiorkor.

a. *Kwashiorkor*

It is more common among children of 1-3 years of age. The most important sign without which a diagnosis of kwashiorltor should not be made is presence of *oedema* (swelling of the body). The swelling is present mostly in the extremities particularly the lower extremities (legs and feet). The investigator can confirm the presence of oederna by applying pressure with the thumb over the skin just above the ankle or feet for a few seconds. It would leave a depression, when thumb is removed, the depression will disappear. In a normal child who does not have any oedema, no such depression would occuc

Children with kwashiorkor are always apathetic and often irritable showing no interest in their surroundings. Their skin and hair (flag signs) may show changes. Kwashiorkor may be associated with other deficiencies and infections. Let us now discuss clinical signs of marasmus.

b. *Marasmus*

Marasmus is characterized by extreme wasting of muscle and subcutaneous fat. The child is very thin, with skin loosely hanging and appears to have nothing but skin and bones. The child has an old man's face and is extremely weak with little strength even to cry. The body weight could be as low as 50% of standard weight for age. Hair will be thin and sparse. The child may bc associated with diarrhoea and other infections.

Let us now discuss clinical signs of marasmic kwashiorkoc

c. *Marasmic kwashiorkor*

Sometimes a child may suffer from clinical signs of both marasmus and kwashiorkor, this child may be having marasmic kwashiorkor. Marasmus with associated oedmea is called as marasmic kwashiorkor. The child therefore would be emaciated and will also have oedema.

Let us go to clinical signs of vitamin A deficiency.

B. Vitamin A deficiency

Deliciency of vitamin 'A' leads to changes in eyes (ocular signs), The ocular lesions - also known as *xerophthalmia* - can be of milder nature, such as night blindness, changes in the white of the eye like conjunctival xerosis or Bitot's spots. The severe lesions of eye affect the black of the eye (cornea). These are corneal xerosis, corneal ulcer or keratoinalacia, which ultimately results in permanent loss of vision. Let us review these manifestations.

a. *Night Blindness*

Night blindness is the earliest symptom of vitamin 'A' deficiency in preschool children. The affected child cannot see properly at dusk. Often, an attentive mother can recognize the child's inability to see the plate of food or toys in ill-lit room.

b. *Conjunctival Xerosis*

Conjunctival Xerosis is recognized by dryness of the conjunctiva, which also becomes thick and wrinkled. It appears rough instead of being smooth and glistening. The dryness becomes more obvious when the conjunctiva is exposed to air for 10-15 seconds by keeping eyelids drawn back.

c. *Bitot's* spots

These are dirty white, foamy and raised spots on the surface of the conjunctiva, generally seen on the outer side of the cornea. Look up Figure 3.3(a) in Unit 3. Bitot spot may appear as a single spot or as several small spots, which may later unite to form a large triangular patch with base towards cornea. Bitot's spots will be stained black when the children use 'Kajal'. The Bitot's spots may appear in only one eye or both the eyes.

d. *Corneal Xerosis*

This is a manifestation of severe Vitamin 'A' deficiency, in which the cornea loses its normal smooth and glistening appearance and becomes dry and rough. Due to inability to see bright light, the child tends to keep the eyes closed and, hence, the condition may be missed during the clinical examination, if not observant.

e. Corneal ulcer

Corneal xerosis, if not treated promptly, leads to ulceration of the cornea. Initially, the ulcer may be shallow, and if it becomes deep, it may lead to perforation resulting in prolapse of contents of the eyeball.

f. *Keratomalacia*

This is a condition of rapid necrosis and liquefaction of full thickness of cornea, leading to prolapse of iris, resulting in permanent blindness. Vitamin 'A' related corneal involvement (ulcer/keratomalacia) could be differentiated from other infective conditions of the eye, by the fact that it is painless and the conjunctiva will be muddy white. In infective conditions, the eye will be red and swollen.

g. *Corneal Scar*

The ulcer of the cornea, on healing, leaves a white scar, which may vary in size depending upon the size of the ulcer. When the scar is big or positioned centrally, normal vision is affected.

Let us now go over to clinical signs of anaemia.

C. Anaemia

Child with anaemia is less active than the normal child. The child may be pale and if the condition is severe, he/she will be breathless and will have swelling of face, body and limbs. The best way to detect anaemia is by examining the inner side of the eyelids, buccal mucosa (top of the roof of the mouth) and nail beds. They appear pale. Similar signs and symptoms also exist among adults, especially in pregnant and lactating women with anaemia. In severe condition, the nails of fingers and toes become papery thin and bend upwards to assume the shape of a spoon. This condition is known as "koilonychia". Haemoglobin estimation in blood is the best way for the diagnosis of anaemia.

Let us review clinical signs of goiter, which is the deficiency of iodine.

D. Goitre

Goitre, deficiency of iodine, manifests as enlargement of thyroid gland situated in the front of the neck as you may recall seeing in Figure 3.4 earlier in Unit 3. In normal

subjects, thyroid gland is neither visible nor palpable. In iodine deficiency, as you may recare seeing in Figure 3.4 earlier in Unit 3 it tends to enlarge in size. A thyroid gland when enlarged to a size of greater than the terminal phalanx of the thumb will be considered as goitrous. Other ill effects of iodine deficiency disorders include cretinism (physical and mental retardation), deaf mutism (deaf and dumb).

E. Vitamin B complex deficiency

Under this, we will review two most common types of vitamin B complex deficiencies - riboflavin and niacin deficiency. Let us review the riboflavin deficiency first.

- *Riboflavin deficiency*

Angular stomatitis, cheilosis, red or magenta tongue, atrophic papillae, and dyssebacea are signs of riboflavin deficiency. A review of there clinical symptoms follows:

a. *Angular Stomatitis*

Ulcers at the angles of the mouth, with fissures, are characteristic of this vitamin deficiency. The fissures may be shallow or deep confined to the angles of the mouth. They may extend into the oral cavity and also on to the skin outside. Milder lesions are identified easily wit11 the mouth half-open.

b. *Glossitis*

The tongue appears bright red or magenta in colour with or without fissures as you may have observed in Figure 4.1(a) in Unit 4 earliec The condition is often painful. The tongue may become completely bald in B complex deficiency.

c. *Cheilosis*

The lips become red and may develop painful fissures and may sometimes get even ulcerated. Let us now look at the niacin deficiency.

- *Niacin deficiency (Pellagra)*

Deficiency of niacin, leads to photo dermatitis (changes in the skin) on the parts of the skin exposed to sunlight, such as cheeks, neck, waist, hands and feet. In acute cases, the affected skin may appear red, slightly swollen and cracked, causing itching and burning sensation. In chronic cases, the skin becomes dry, rough and thick with brown pigmentation. Red and raw tongue with fissures and atrophic papillae are also seen in niacin deficiency.

Let us now review the clinical signs of vitamin C.

F. Vitamin C deficiency

***Spongy** bleeding gums*

Gums are swollen (spongy) and bleed with even slightest touch. There may be associated petechial haemorrhages, ecchymosis and painful epiphyseal enlargement of bones.

We will now review the clinical signs of deficiency of vitamin D.

G. Active Rickets

It is due to vitamin D deficiency and is characterized by painless epiphyseal enlargement of growing ends of the long bones, beading of ribs, persistently open anterior fontanelle (after 18 months of age), craniotabes (parietal or occipital bones of skull become soft, and dent on pressure which spring back to normal shape when pressure is released (in children of <1 year), and muscular hypotonia. Healed rickets is characterized by the prominence of frontal and parietal bones of skull (referred to as frontal/parietal bossing), knock-knees (knees touching each other) /bow legs (legs becoming curved)

due to inward or outward lateral bending of lower limbs, as a result of weight bearing. Look up Figure 4.4 in Unit 4 earliar for viewing there clinical manifestations.

Let us move on to essential fatty acid deficiency.

H. Essential **fatty** acid deficiency

Phrynoderma: Phrynoderma is *a hyperkeratotic* lesion *of the* ***skin.*** Projectio7ns that resemble cones are formed surrounding the mouths of hair follicles. It is readily recognized by the spiky feeling it gives, when the palm is passed over the affected skin. It is generally seen on back of elbows, around knees and sides. They may sometimes be pigmented and the surrounding skin is dry.

Let us review the clinical signs of fluorosis - a condition caused by excess intake of fluorine.

I. Fluorosis

Earlier stages of fluorosis are characterized by changes in teeth known as *dental fluorosis.* Normal teeth are ivory white in appearance. In fluorosis, the teeth are mottled (with yellowish streaks) and appear chalky white (opaque) with brownish patches as you may recall seeing in Figure 4.5 eailier in Unit 4. Sometimes, pitting or chipping of enamel is seen, especially in the upper incisors. In areas of severe endemic fluorosis, many adolescents and young adults may also have skeletal deformities particularly in spine.

For your convenience, the various signs and symptoms of the nutrition deficiency disorders, we have discussed above are summarized in Table 8.1.

Table 8.1: Nutritional deficiency **disorders** and **signs and symptoms**

Nutritional deficiency disorders	**Signs and symptoms**
Kwashiorkor	• Oedema • Underweight (<80% of normal weight for age) • Apathy and irritability • Moon face • Hair and skin changes
Marasmus	• Extreme muscle wasting - "skin and bones" • Loose and hanging skin folds • Old man's or monkey race
Marasmic kwashiorkor	Extreme muscle wasting - "skin and bones" • Loose and hanging skin folds • Old man's or monkey facies • Absolute weakness • Oedema
Vitamin A deficiency	Changes in the eye such as • Conjunctival xerosis:dryness of the transparent membrane that covers the cornea and lines inside of the eyelid

	• Xeropthalmia (including Iteratomalacia): cornea becomes soft and raw and easily infected • Bitot's spot dry foamy, triangular spots appearing on the temporal side of the eye • Night blindness: inability to see in dim light
Iron deficiency anaemia	• Paleness of conjunctiva, • Paleness of tongue • Paleness of mucosa of soft palate • Low haemoglobin • Swelling of feet in severe anaemia • Spoon shaped nails
Iodine deficiency disorder	• Thyroid enlargement: gland visible and enlarged • Abortions, Congenital abnormalities, • Cretinism
Riboflavin deficiency	• Angular stomatitis- lesions on both angles of the mouth • Glossitis - Tongue bright red or magenta Cheilosis - Lips become red and develop cracks
Niacin deficiency	• Dermatosis - Symmetrical skin lesions evident only on areas exposed to sunlight
Vitamin C deficiency	• Spongy bleeding gums
Rickets	• Changes in skeletal system- such as beading of ribs, pigeon chest: protruding breast bone, knock-knees or bow legs
Essential fatty acid deficiency	• Lesions in the skin-generally seen on back of elbows, around knees and sides
Fluorosis	• Mottled teeth with chalky white and brownish areas with or without erosion of enamel

We discussed above that we can assess various nutritional problems by looking at the clinical signs in the person. We will now cliscuss the next method of direct nutritional assessment which is the biochemical assessment. But, first let us recapitulate what we have learnt so far.

Check Your Progress Exercise 1

1. What are the other three methods of direct assessment of nutritional status in addition to nutritional anthropometry?

.....

.....

.....

2. What do you mean by clinical assessment?

.....

.....

3. List two clinical signs each of the following nutritional disorders.	
Nutritional disorders	Clinical **signs**
Kwashiorkor	
Vitamin A deficiency	
Anaemia	
Iodine deficiency	
Riboflavin deficiency	
Niacin deficiency	
Vitamin C deficiency	
Rickets	
Fluorosis	

Now let us learn about the biochemical assessment.

8.3 BIOCHEMICAL ASSESSMENT

Biochemical assessment deals with *measuring the level of essential dietary constituents (nutrient concentration, metabolites) in the body fluids (normally blood and urine) which is helpful in evaluating the possibility of malnutrition* We have learnt in the previous unit that in the development of nutritional deficiency disease, certain biochemical changes occur before clinical changes take place. These are also considered to indicate sub clinical nutritional status with reference to various nutrients. The range of biochemical tests that can be used is considerable. Before we go into details about various biochemical tests, we will give you an overview of biochemical tests. Let us begin with an overview of biochemical tests.

8.3.1 Biochemical Tests - An Overview

Before we conduct a biochemical test, there are some important points about which we should know. These are: what is an ideal biochemical test, what criteria do we use for selection of field test, what precautions do we use while performing a test, why do we need accuracy and what is the importance of standardization in these tests. Let us find out the answers to these questions next.

What is an ideal test?

An ideal biochemical test suitable for field survey should be *sensitive* (easily identify most positives), *specific* (easily identify normal subjects), *easy to carry out,* preferably non-invasive and *inexpensive.* It should reveal information on the extent of tissue unsaturation rather than the fluctuations that occur with variations in the diet. However, it is often difficult to have a biochemical test satisfying all these specified conditions. The choice of the test depends on the actual aim i.e. to make diagnosis of population surveys.

What is the criterion for selection of field tests?

In the field conditions, the selection of the tests will be limited by the need for single-specimen tests rather than tests required more than once, age groups (collection of blood samples in young children being difficult), the site of collection of blood samples (finger-prick vs. veni-puncture samples), availability of laboratory facilities and skilled manpower. Thus, for field surveys, finger-prick blood samples and random samples of

urine are more preferred. In a large-scale field survey, it is often not possible to collect fasting samples of blood like for assessment of the extent of diabetes mellitus. The samples should be stable particularly during transport, not requiring refrigeration, as far as possible, and should not be affected by the recent meal or water consumption. In view of this, currently, tests involving dry *blood spot methods* are being developed. For example, such tests are already available for estimation of haemoglobin and serum vitamin A. It is often suggested, considering the logistic difficulties and the cost of the tests, that biochemical assessment be carried out in a sub sample of the study population.

What precautions do we take while performing a biochemical test?

Another important factor of consideration is use of disposable lancets for finger pricking and of disposable syringes for venipuncture specimens to avoid the danger of hepatitis and I-IIV infections. Even the investigators collecting the blood samples should wear disposable gloves as a precautionary measure against these.

The commonly included biochemical investigations in some routine field surveys are estimation of haemoglobin to assess the extent and distribution of anaemia and urinary iodine estimation to assess iodine status of the communities. In specific surveys for the assessment of sub clinical deficiency of vitamin A deficiency, estimation of serum vitamin A is also being attempted.

Next, let us get to know why there is a need for accuracy and standardization of procedures in biochemical assessment.

Why there is a need for accuracy?

In the selection of methods for field surveys, accuracy and precision should not be sacrificed for the sake of convenience. For example, in large scale national surveys in India 'haemocue' was used as it was simple and required a drop of blood for estimation of haemoglobin. Subsequent investigations have revealed that 'haemocue' gives higher values of haemoglobin in countries like India, where anaemia is widely prevalent leading to underestimation of the prevalence. Thus, in the selection of methods and equipments, appropriate care should be taken.

Why standardizing the procedures?

As discussed earlier, it is very important to standardize the procedures and the investigators for accurate measurements. All the equipment should be tested 'for their accuracy and necessary care should be taken to carry voltage stabililizers in rural areas where electricity fluctuations are very common. The training of the investigators should be such that the *between observer* and *within observer variations* should be within the allowable minimum ranges. It should be recognized that errors could lead to inaccuracy, if the procedures of collection of samples are not proper. Cold storage of the biological specimens is most often required and adequate arrangements should be made for the purpose. If the samples are collected elsewhere and are transported to the laboratory, steps should be taken to provide for cold thermos flasks, which would keep cool for sufficient length of time.

Having learnt about the basic concepts of biochemical assessments, it is now the turn of biochemical tests i.e. let us review the different biochemical tests which can be used to assess nutritional status.

8.3.2 Biochemical Tests for Nutritional Deficiencies

We will now discuss the different biochemical tests used to assess nutritional status of community. It may be mentioned that the information on methodology for conducting the various tests is not provided in this section, since it is not within the purview of this unit. If you are interested to know about the methodology, we suggest you look up the publications on laboratory methods of biochemical tests in any library or perhaps

find it on the internet. Here our focus will be to learn about the different tests that could be used to assess the sub clinical status of various nutritional deficiencies and about the interpretation of results. The nutritional deficiencies that we will discuss are:

A. Protein energy malnutrition,

B. Vitamin A deficiency,

C. Anaemia,

D. Iodine deficiency,

E. Vitamin D deficiency, and

F. Other nutrients like riboflavin, niacin, folic acid, vitamin B_{12} and zinc.

Let us start with protein energy malnutrition.

A. Protein **Energy** Malnutrition

In most situations, dietary protein deficiency is secondary to calorie deficiency, dietary protein deficiency may be a specific problem only in some clinical conditions. The principle is that in protein deficiency, proteins and its derivatives are lowered. A number of tests like *serum* proteins, *urea creatinine ratio* and *hydroxyproline* **index** have, therefore, been suggested to assess protein nutritional status. However, these are not sensitive indicators of early protein malnutrition and do not provide any additional information over anthropometry. However, in clinical practice and nutrition surveys, serum albumin is the preferred method. Serum albumin reflects the long-term changes in protein nutritional status. The guidelines for detertnining changes in protein nutritional status of children using serum albumin as an indicator are presented in Table 8.2.

Table 8.2: Serum albumin levels as an indicator *to* assess protein nutritional status in children < 5 years of age malnourished children

S.No.	Protein nutritional status	Serum albumin levels (g/100ml)
1.	Deficient (high risk)	< 2.8
2.	Low (medium risk)	2.8 - 3.4
3.	Acceptable (low risk)	> 3.5

Serum proteins, though are used in some cases, but can be raised during infections, which are very frequent in rural preschool children. Hence, we need lo consider this aspect while using this measure. You can note from Table 8.2 that different serum albumin cut-off values are used to indicate deficiency (high risk), low or medium risk and acceptable cases.

Let us go to the vitamin A deficiency assessment tests next.

B. Vitamin A Deficiency

There are three methods to assess vitamin A deficiency. These include:

1) Serum retinol method,

2) Relative dose response method, and

3) Filter paper method.

Let us get to know them.

1) Serum retinol method

Serum retinol or serum vitamin A is generally the simplest and feasible method of assessment of vitamin A status in communities. It may be noted that this indicator does not indicate the true tissue status of vitamin A. The guidelines for determining the vitamin A status based on serum retinol is given in the Table 8.3.

Table 8.3: Vitamin A status based on serum Vitamin A levels

S.No.	Vitamin A status	Serum vitamin A levels	
		ug/dl	Umol/litre
1.	Deficient (high risk)	< 20	< 0.7
2.	Low (moderate risk)	20 - 30	0.7 - 1.05
3.	Acceptable	> 30	> 1.05

Vitamin A is regarded as public health problem in a community if serum vitamin A levels are <10 µg/dl or <0.37 µmol/litre in more than 5% of children under the age of six years. In other words, in such communities, there is a need for initiating nutrition intervention programmes like vitamin A supplementation.

Let us now learn about the second method which we can use to assess vitamin A status,

2) *Relative dose response method*

A new method known as ***Relative*** *dose response (RDR)* is considered to be a better indicator of vitamin A stores in the body. Increase (%) in serum vitamin A levels is measured after a small oral dose of 450-1000 µg of vitamin A. The post dose is inversely related to the vitamin A status of the individual. An increase >20% is indicative of vitamin A deficiency in an individual. The limitation of the test is that it requires taking blood samples twice, which may not be feasible in young children particularly in community surveys. This limitation could be got over in Modified Relative Dose Response (MRDR) test where only one blood sample after administration of a prescribed dose (100 µg / kg body weight) of dehydroretinol (vitamin A_2) is taken. However, it is often difficult to procure vitamin A_2. A ratio > 0.06 of vitamin A_2/ vitamin A is suggestive of deficiency. The major limitation of serum retinol estimations is the requirement of sophisticated and expensive instruments like High Pressure Liquid Chromatography (HPLC). Finally let us learn about the filter paper method.

3) *Filter paper method*

In the filter paper method, a blood spot is collected on a special filter paper and dried and carried to a laboratory for estimating serum retinol levels. This method though is simple, requires HPLC and the samples should be kept in cold storage. These facilities may not be available in many areas.

Next, let us learn about the biochemical assessment methods for the presence of anaemia in individuals.

C. Anaemia

Nutritional anaemia, as you may already know, is the most widespread of all the nutritional deficiencies. It is largely due to iron deficiency though folate deficiency is also observed in poor communities. There are two main methods used to assess iron deficiency. These are: 1) measurement of haemoglobin, and ***2)*** estimation of iron stores. Let us review these now,

1) *Measurement of haemoglobin*

Measurement of haemoglobin is the simplest method to assess nutritional anaemias in communities, In fact in view of the subjective bias in identifying clinical anaemia, haemoglobin estimation is adopted in large-scale surveys. It requires 20 µl of finger-prick blood sample, collected in a haemoglobin pipette and is estimated by cyanmethaemoglobin method by colorimetly. Inexpensive models of colorimeters are available in India now. Earlier in sub-section 8.3.1, we studied about the Haemocue method which is also used to assess haemoglobin levels. Because haemocue is easy to use in a field situation, it is recommended for use. However, it has few limitations specific to accuracy, which needs to be considered.

The criteria for diagnosing anaemia as recommended by the World Health Organization are given in Table 8.4.

Table 8.4: **WHO** guidelines for **diagnosing anaemia**

Group	Cut-off for Haemoglobin (g/100 ml)
Children < 6 years	11
Children > 6 years Adolescents	12
Non-pregnant and non-lactating adult women	12
Pregnant women	11
Lactating women	12
Adult males	13

Cases with values lower than the cut off suggested in Table 8.4 are considered anaemic.

Next let us learn about methods of estimating iron stores in the body.

2) Estimation of Iron Stores

Estimation of either *bone-nzarrow* iron or *serum ferritin,* both of which are lowered, indicates the earliest stage of iron deficiency. Other than serum ferritin, *transferrin saturation, erythrocyte protoporphyrin* and *serum transferrin receptors* are the other measures used to examine the prevalence of iron deficiency. Let us get to know about these measures.

Serum Ferritin (SF) test permits an evaluation of the storage iron level of a population. At all ages, serum ferritin levels <12 µg are strongly suggestive of iron deficiency. What we need to know here is that any inflammatory condition can also lead to increase in serum ferritin levels and, therefore, should be excluded. Serum iron is also estimated to assess iron deficiency. Serum iron levels < 40 µg/dl and transferring saturation of <15% are suggestive of iron deficiency. *Transferrin saturation* helps to determine whether the supply of iron is appropriate for the bone marrow, which is responsible for the production of haemoglobin and red blood cells. This is a ratio (expressed as percentage) of serum iron and total iron binding capacity. The normal value is **33%.** A low transferrin saturation and serum iron are characteristics of both iron deficiency, and recent or concurrent infection. *Erythrocyte Protoporphyrin,* like, transferrin saturation, helps to determine the supply of iron. Erythrocyte protoporphyrin is elevated in cases of iron deficiency (i.e. when there is insufficient supply of iron for heme synthesis). In children below the age of four, values > 80 µg/dl of red blood cells are indicative of iron deficiency. *Serum transferrin receptors,* is a new test for the evaluation of iron status. Measurement of circulating transferrin receptor, on cell surfaces and in plasma, provide a reliable index of iron deficiency anaemia. *Transferrin receptors* become elevated whenever there is insufficient iron supply to cells or iron depletion.

The criteria generally used to diagnose iron deficiency is listed in Table 8.5.

Table 8.5: Diagnostic criteria for iron deficiency anaemia

Indicator	Cut-off point
Serum Iron (µg/dl)	< 60
Total iron binding capacity (µg/dl)	> 300
Transferrin saturation (%)	< 15
Erythrocyte protoporphyrin (µg/dl)	> 100
Serum ferritin (µg/l)	< 12

In view of the need for laboratory facilities and skilled man power these tests are carried out only on a limited scale.

Next, let us go over to tests related to iodine deficiency.

D. Iodine Deficiency

Urinary iodine levels reflect the iodine status in a community. On adequate dietary iodine intakes, the median urinary iodine is 100 µg/L and is considered as normal. In other words, in areas with adequate iodine intakes, in half of the population urinary iodine level will be >100 µg/L. Similarly, if in > 20% of the subjects, urinary iodine levels are < 50 µg/L, the population is considered to be iodine deficient. The cut-off points for defining the iodine status of a population according to the median urinary iodine concentration are given in Table 8.6.

Table 8.6: Criteria for defining the iodine status of a populataion based on median urinary concentration

Iodine status	Median urinary iodine concentration (µg/dl)
Severe iodine deficicieny	< 20
Moderate iodine deficiency	20 - 49
Mild iodine deficiency	50 - 99
Ideal iodine intake	100 - 200
More than adequate iodine intake (may increase the risk of iodine induced hyperthyroidism)	201 - 299
Excessive iodine intake	> 300

Let us now discuss the biochemical tests for vitamin D deficiency.

E. Vitamin D Deficiency

Clinical forms of vitamin D deficiency are rare in community surveys and cases of rickets are seen only in hospital practice. Serum levels of ***25-hydroxy*** *cholecalciferol* or 25 *HCC* (which you may recall reading in the Nutritional Biochemistry Course, Unit **3,** is a metabolite of vitamin D) are the accepted indicators of vitamin D deficiency. Levels >10 ng/ml (25 nmoles/l) are considered acceptable while 5-10 ng/ml as low and < 5 ng/ml as high risk.

Let us go over to the biochemical tests for deficiency of other nutrients.

F. Other Nutrients

Biochemical tests related to the deficiency of other nutrients i.e. riboflavin, niacin, folic acid, vitamin B_{12} and zinc can also be considered, for assessing biochemical status of community. These are indicated in Table 8.7. These are carried out in specific surveys.

Table 8.7: Biochemical tests and criteria for nutritional deficiencies

Nutritional deficiency	Test	Deficiency Criterion
Riboflavin	1. Urinary Riboflavin 2. Erythrocyte Glutathione Reductase (EGR) test	< 80 µg/g of Creatinine >1.7 (high risk)
Niacin	Ratio of N'- methyl -2-pyridone-5 carboxylamide and NI-methylnicotinamide	< 1
Folic acid	Serum Folate	< 3ng/ml
	RBC Folate	140 ng/ml
Vitamin B_{12}	Serum B_{12}	SO pg/ml
Zinc	Plasma Zinc	< 84µg/dl

Inteipretation of biochemical parameters is often complicated. It is not frequent to observe florid cases of clinical nutritional deficiencies with normal biochemical values at the community level. Other factors like dietary intakes and bioavailability of nutrients should be considered for proper interpretation of the biochemical values. A common example is total goiter rate (TGR) and urinary iodine levels, despite the TGR being in the endemic range, the median urinary iodine values are normal. In such cases, the distribution of biochemical values would be better.

We hope having gone through the discussion above, you would now be in a good position to identify the biochemical tests which you would use while conducting nutritional assessment of population groups. Let us take a break here and then answer the questions given in check your progress exercise 2.

Check Your Progress Exercise 2

1. What do you understand by biochemical assessment? What are the characteristics of an ideal biochemical test?

.....

.....

2. Match the following biochemical tests in column A with the nutritional deficiencies in column B.

Column A	Column B
1. Serum albumin	a. Goitre
2. Serum retinol	b. Anaemia
3. Haemoglobin	c. PEM
4. Urinary iodine	d. Vitamin A
5. Serum folate	e. Riboflavin
6. erythrocyte glutathione reductase	f. Folic acid

3. What are the methods to assess:

a) Vitamin A deficiency

.....

.....

.....

b) Iodine deficiency

.....

.....

.....

We have learnt about the clinical assessinent and biochemical assessment as methods of direct nutritional assessment. Let us now study about the last method i.e. dietary assessment of nutritional status.

8.4 DIETARY ASSESSMENT

Dietary assessment is conducted with the help of diet surveys. When a *systematic inquiry into the food supplies and food consumption of individuals and population groups is made, we call it a diet survey.* Diet surveys, most often are a past and parcel of routine nutrition surveys. Accurate inforination on dietary patterns of communities would help in assessing the nutritional status of people but also for determining the relationship between nutrient intakes and deficiency diseases. These would help in understanding the dietary status of the community vis-á-vis other indicators of nutritional status lilce anthropometry, clinical signs of deficiency or biochemical parameters. Sometimes, dietary assessment of subjects in an institution like hostels or prisons also may be required to assess the adequacy of diet for any modifications. An appraisal of the dietary adequacy for populations would be required for planning programmes to overcoine diet related disorders and to promote nutrition in general. Quantitative data on dietary intakes of populations are taken into consideration for fixing minimum wages and rations for households. In the recent past, assessment of the extent of poverty is based on dietary energy consumption pattern.

The dietary intakes can be assessed quanlitatively either at the family or individual level. Sometiines institutional diet surveys are also important to find out the dietary intakes of individuals in large institutions. We would now study about common methods to assess dietary intakes at various levels.

The commonly used methods are:

- Family/Household Diet Survey
  - a. Weighment method
  - b. Consumption Expenditure Survey
- Assessment of dietary intakes of individuals
  - a. Individual Oral Questionnaire (24 hour recall method),
  - b. Food Record or Diary and
  - c. Diet History.

- Qualitative Survey
- Institutional Diet Survey
- Food Balance Sheets

Let us begin with dietary surveys for the family.

8.4.1 Family Diet Surveys

Family diet surveys collect information on diet at the household level. The results are expressed as per capita or per consumption unit. In these surveys, it is not possible to find out the intakes of particular age groups or physiological groups. Since these are simpler than 24-hour recall individual diet surveys about which he will study later in this unit, routine nutrition surveys adopt these methods. These methods include: weighment method and consumption expenditure surveys.

Let us learn about these methods in details. Let us begin with weighment method first.

A. Weighment Method

Weighrnent method of diet survey involves actual weighing of raw foods on a given day. The investigator visits the households before the food is cooked and weighs with the help of a grocer's balance or on a electronic balance all the foodstuffs (edible portions) that will be cooked for the day.

Earlier, weighment of foods was being carried out on seven consecutive days and the method was known as *seven-day weighment method.* Seven day surveys were logistically more difficult and time consuming. They also required complete cooperation of the households selected for the purpose. In the nineteen sixties, considering the monotony of the rural Indian diets with hardly any variation in the diet, after comparing the results of seven day and one day methods, it was decided to adopt one-day weighment diet surveys for assessing family dietary status in villages. Even now, in the urban areas, 3-day weighment is adopted, since there is more variation in these diets. Under weighrnent method, all the raw food items (edible) are weighed according to meal pattern(i.e. breakfast, lunch, evening tea and dinner) for the day of survey using grocer's balance and local measures. Information on all the family members who will be consuming the meal on that day is collected according to age and physiological status. In the case of young children, information on breast-feeding and complementary feeding practices is also collected. The respondent (house wife) is requested to bring all the raw foodstuffs she will be using for that day's menu. Each food item is weighed carefully and the weights are recorded in a proforma. The team is expected to visit the house as many times as the food is cooked and weigh all the foods that will go into the meal. However, in practical terms, often this may not be possible as the family may have foods just adequate for one meal and for the evening meal foods may be purchased only after the day's wages are collected. Therefore, information about what the quantities of foods would be, is collected from the respondent. It is also important to collect information about foods eaten outside home, supplementary food given to young children and food that is left over at the end of the day. In certain areas, even the cattle are fed either chapatis (roties) or rice. This information should be collected lest there will be overestimation of the intakes. As far as possible, the survey should not be carried out either on feasts or fasting days. Similarly, on occasions when special guests are present, the diet may not represent the actual intakes in the family. In the urban areas, the data is collected in the same way for three consecutive days.

The dietary consumption is usually expressed *per consumption unit* (CU), which represents the intake of a sedentary adult male. These consumption units are calculated based on the calorie coefficients suggested based on the calorie requirements for different age, sex and physiological groups. The calorie requirements for one consumption unit are 2400 kcals. The Indian Council of Medical Research (ICMR) recommends the following calorie coefficients as given in Table 8.8, considering the value for a sedentary adult male as 1.

Table **8.8:** Calorie coefficient expressed in relation to consumption units (CU) for **age/sex/activity** levels

Age/ sex/physiological group	**CU**
Adult Male – sedentary	1
Adult Male – moderate activity	1.2
Adult Male – Heavy Activity	1.6
Adult Female – sedentary	0.8
Adult Female – moderate activity	0.9
Adult Female – Heavy Activity	1.2
Adolescents (12-21 years)	1.0
Children – 9-12 years	0.8
Children – 7-9 years	0.7
Children – 5-7 years	0.6
Children – 3-5 years	0.5
Children – 1-3 years	0.4

The total number of consumption units in each family is first calculated based on the information on age, sex, activity, and physiological status of all the individuals in the family. The number of consumption units will be less than the total number of members in the family. We can calculate intake of each food per consumption unit as follows.

$$\text{Intake of each food/CU per day} = \frac{\text{Raw amounts of each food}}{\text{No. of consumption units}}$$

We can explain this with the help of an example. Suppose we have a family of four consisting of two adults and two children in a household, we can calculate the total consumption units as shown in Table 8.9.

Table **8.9:** Calculation of total consumption units by a family **of four people**

Characteristics	Adult male	Adult female	**Child (3yrs)**	Child (7 yrs)
Family composition	1	1	1	1
Type of activity	Moderate	Moderate		-
Physiological status	-	(Non pregnant, non lactating)	-	-
Equivalent consumption unit(C.U.)	1.2	0.9	0.4	**0.6**

We can note from the Table 8.9 that total CUs for this family are 3.1. We can now take the example of rice being consumed by the family and can calculate the intake of rice/CU per day as follows. Suppose during the survey of this family, if the total intake of rice is found to be 400 g/day, then intake of rice/CU/day = Total intake of rice/total CU= 40013.1 = 129 g. In this way, we can determine the intake of each food/ CU/day for each food consumed by the family.

The raw foods are converted into nutrients using the food composition tables (Nutritive Value of Indian Foods, National Institute of Nutrition, 2004), which provide nutrient content of commonly consumed Indian foods. These are then compared with the recommended dietary intakes suggested by Indian Council of Medical Research(ICMR) for different nutrients for sedentary adult male to find out the adequacy or otherwise of the diets in the family. The data obtained on all the families is then summed up to calculate the average intakes of the coinmunity surveyed. The major limitation in the method is that consumption units are computed on the assumption that calorie coefficients hold good for all the nutrients. Sometimes, the data are also expressed per caput (per head) by dividing the total consumption of foods by the total number of members (every member is treated as equal irrespective of age/sex/physiological status) who have partaken in the meal.

Having gone through the discussion above, you must have understood thc weighment method and per consuinption unit concept. Next, we move on to the consumption expenditure survey.

B. Consumption Expenditure Survey

In the consuinption expenditure survey, the money spent on all the food and non-food items for a fixed period in the immediate past (usually one month) is found out by administering a specially designed proforma. This is considered to be comparable to the results of weighment diet survey. The *National Sample Survey Organization* collects such information every five years. In fact, the extent of poverty in the country is calculated based on the results of food consumption surveys. The results provide information on foods bought by the family, which need not always mean actual consumption.

Having studied about the family diet surveys, next, we move on to the assessinent of dietary intakes for individuals.

8.4.2 Assessment of Dietary Intakes of Individuals

Dietary status of individual "at risk" groups is often required to plan specific programmes for that group. For example, information of actual intakes of preschool 'children or pregnant women who are considered more vulnerable is essential to assess the actual deficit in the diets and to decide the quantities of supplements to he provided in the intervention programmes. We will discuss three types of methods used to collect information on dietary intakes of individuals. These are:

a. Individual Oral Questionnaire (24-hour recall method),

b. Food Record or Diary, and

c. Diet History.

Out of these, the *24-hour* recall *method* is probably the mostly widely used method of dietary assessment. We will now discuss these methods in details. Let us begin with the 24-hour recall method.

u. Individual Oral Questionnaire (24-hour Recall Diet Survey)

The 24 hour recall method is used in large nutritional surveys to collect dietary intake data of individuals. In this method, the individual is asked to recall in as much detail as possible the food intake for the past 24-hours by interview or by completing a questionnaire. The respondent recalls what *was eaten, how much food was eaten, how was the food prepared, when was it eaten and other details related to food intake.* However, while conducting the survey, both the respondent and the housewife (or the person who cooks the food for the whole family) is contacted. The dietary intakes are assessed in terms of cooked food with the help of standardized cups measures appropriate for the local conditions, These cups are used to help the

respondent to easily recall the quantities of food consumed by each member. These cups (generally about 12 with a teaspoon and a tablespoon) are first standardized in terms of volumes. These are so selected to represent the sizes of vessels used in the household. The respondent is questioned about the preparations made for each meal starting from the morning tea. For each preparation (say vegetable curry), all the ingredients (i.e. individual vegetables, oil, spices, salt etc) used are first listed. The housewife is then asked to give the actual weights of each of the food ingredient used in each preparation. This will give the quantities of total raw food used for the family. She is later asked to indicate in terms of the standardized cups the total volume of each preparation after cooking. This would give the total cooked quantities for each food item. For example, the volume of cooked rice may be 2-3 times of the raw amount depending on the age of the rice. Then the respondent is asked the amounts of cooked food consumed by each individual in the family who has partaken the meal. This would provide the individual intake of cooked food. This is repeated for each meal for each preparation. To check the accuracy of the assessment of the volumes by the housewife, it would be always better to take same volume of water to assess the total cooked quantity in the vessel used by her. This is then measured in terms of the standardized cups. Some times, previous day's remaining food may be consumed in the morning. Information about the total raw, cooked amounts may be assessed as described earlier and the individual consumption is assessed. The guidelines for conducting a diet survey using a 24-hour recall method are attached in *Annexure 1A*. A schedule for 24-hour recall method is attached at *Annexure 1B* at the end of the course material.

Well, there are certain points to remember while doing the 24-hour recall? What are they? Let us find out.

We should remember that while doing a 24-hour recall, each and every ingredient used in the preparation of meals should be included. In the case of milk/curds/buttermilk, the extent to which these were diluted should be found out, as it is a common practice in rural families. In the case of bread, the number of slices per loaf should be assessed so as to approximately assess the weight of each slice. In the case of rotis or pancakes, the number should be recorded. A thorough knowledge of the local measures, the preparations, and the method of preparation is essential for obtaining valid results.

Thus, for the purpose of calculation, the important step is to convert the individual cooked intakes into raw amounts of each food item as shown in the formula herewith.

$$\text{Individual Raw Intake} = \frac{\text{Total raw amount for each food item (g) x Individual cooked intake (vol.)}}{\text{Total cooked amount of the preparation (vol)}}$$

This calculation is repeated for each and every food item that was used in the meal and the total amounts consumed by each individual of each food item are computed. From the raw amounts, the nutritive value of each food item is calculated using the food tables as indicated earlier. It is often recommended that the information may be collected on all the members of the family even if the info mation is required for a particular group. The advantages are that this provides an opportunity to find out the intra-family distribution of diet and to assess whether a particular group is at a more disadvantage. Literature reveals that in India the dietary distribution is unfavourable to preschool children in the sense that even if other members in that family meet the requirement of nutrients like energy, a significant percentage of prescliool children are given inadequate energy diets..

The 24-hour recall has several strengths. It is inexpensive and quick to administer (20 minutes or less) and can provide detailed information on specific foods. It requires only short term memory. It is well accepted by respondents because they are not asked to keep a diet records and their expenditure of time and efforts is relatively low. The method also has several limitations. Individuals may withhold or alter information about what they ate due to poor memory or embarrassment or to please or impress the interviewer and researchers. Also data on a single day's diet, no matter how

accurate, are a very poor descriptor of an individual's usual nutrient intake because of day-to-day or intra individual variability. However, a sufficiently large number of 24 hour recalls may provide a reasonable estimate of the mean nutrient intake of a group.

Let us now move on to the next method of assessing individual dietary intake i.e. Food Record or Diary.

b. Food Record or ***Diary***

Food record or diary method provides food consumption data of individuals. Under this method, the subject records, at the time of consumption, the type and amounts of all foods and drinks consumed for a period of time usually ranging from 1 to 7 days. Portion sizes are estimated using food models and standard measuring instruments or food items are actually weighed. The strengths of the food record method are that it does not depend much on memory because the subject records food and drink consumption at the time of eating. In addition, it can provide detailed food intake data and important information about eating habits (for example, when, where, and with whom meals are eaten). However, the main limitation of this method is that recording food intake requires a literate and cooperative subject who is willing to spend the time and effort. Individuals having the time, interest and ability to complete several days of food records without assistance may not. be representative of the general population.

Let us now move on to the third method of assessing dietary intake of individuals i.e. diet history.

c. Diet History

Diet history yields a retrospective estimate of food and nutrient intake of an individual over a period of time. The period covered may range from a month to one year at the most. Traditionally, the diet history approach has been associated with the method of assessing usual diet developed by a scientist, B.S. *Burke*. Burke's original method involves four steps; 1) collect general information about the subject's health habits 2) conduct 24-hour recall to get information on the subject's usual pattern of eating, **3)** perform a cross check on the data given in step 2, and 4) have the subject complete **a** 3 day record.

Let us review these steps briefly.

1) Collect general information about the subject's health habits: Information is collected from the individual about the number of meals eaten per day, appetite, food dislikes, the presence or absence of nausea and vomiting, use of nutritional supplements, habits related to sleep, rest and work etc. This allows the interviewer to become acquainted with the subject in ways that may be helpful in obtaining further information.

   Next, collect 24-hour recall to get information on the subjects usual pattern of eating. Let us see how.

2) Conduct 24-hour recall to get information on the subject's usual pattern of eating: A 24-nour recall is conducted with the subject using the technique as discussed earlier. The information is thus collected on subject's usual pattern of eating during and between the meals including types of food eaten, serving sizes, frequency and timings. Next perform a cross check on this data as explained next.

3) Perform a cross check on the data given in step 2 above: Once the information on 24 hour recall is collected,, the data is then cross checked by asking specific questions about the subjects' dietary preferences and habits. For example, the subject may have said that he or she drinks 200 ml of milk every morning, The interviewer should then inquire about a subject's milk drinking habits to clarify and verify the information given about the subject's milk intake.

4) Have the subject complete a 3 day record: Finally the subject is asked to complete a 3-day record, which serves as an additional means of checking the usual intake.

As we said earlier, this is an approach suggested by *B.S. Burke*, but several investigators have modified it to suit their needs. The strengths of the diet history approach are that it assesses the subject's usual dietary intake, including the seasonal variations, and therefore, data on all nutrients can be obtained. The main limitation of this method is that it requires 1-2 hours to conduct the interview. Highly tsained interviewers are needed and nutrient intakes tend to be overestimated.

Thus, the three methods discussed above provide information on nutrient intakes of individuals. We can choose any method depending upon the objectives of our study, time and resources at hand although the 24-hour recall method remains a method of choice for large scale nutritional surveys.

The methods discussed above provide quantitative information about the diet. Sometimes we may want to collect only qualitative information about the diet. Let us get to know about qualitative diet surveys.

8.4.3 Qualitative Diet Surveys

Il1 certain instances, quantitative information on dietary intakes may not be required. Under such circutnstances, qualitative data is compiled by carrying out surveys either at family or individual level. In such surveys, information is compiled on the kinds of foods eaten, the frequency of their consumption, perceptions of the corninunity about foods, attitudes towards different types of foods and the special foods consumed during particular conditions like pregnancy or lactation. An attempt is also made to collect data on the foods avoided during health and disease and foods restricted during morbidities. This data is useful for planning and evaluation of nutrition education programmes. Such data is collected through specially designed proforma.

We can study about one of such method in detail. This is known as food frequency method.

Food Frequency Method: Food frequency inethod consists of asking individuals (by interview or checklist) how often (daily, monthly, weekly) specific foods are eaten. This is then used as an index of diet pattern of population groups. The underlying principle of food frequency method is that average long term diet, for example, intake over weeks, months or years, is the conceptually important exposure rather than intake on a few specific days. Therefore, it may be advantageous to sacrifice precise intake measurements obtainable on one or a few days in exchange for more crude information relating to an extended period of time. In fact, food frequency methods has become the priinary method for measuring dietary intake in epidemiological studies as they are easy for subjects to complete, often as self-administered form. A food frequency questionnaire or checklist consists of two components: *a food list* and *a frequency response section* for subjects to report how often each food was eaten. Refer to *Annexure* 2 given at the end of this course. A food frequency questionnaire is given for you reference in this annexure. The questionnaire consist of a list of approximately 100 or fewer individual foods or food groups that are important contributors to the population's intake of energy and nutrients. Usually, the foods are grouped into categories (based on similarity of nutritive value, functions in the diet etc.). The strengths of food frequency questionnaire are that they are relatively inexpensive and quick to administer in large scale surveys. They are also considered one of the methods of choice for research on diet-disease relationships on both the macronutrient and micronutrient levels. The key limitation of food frequency questionnaire is that since the food list is limited to 100 or fewer foods and food groups, these must be representative of the most common foods consumed by individuals in a sample.

Sometimes we would like to know the dietary intake of large groups of people consuming food in an institution. For this, we use an institutional diet survey. Let us get to know about them.

8.4.4 Institutional Diet Survey

Institutional diet survey is used *to find out the dietary pattern of people residing in hostels, orphanages, prisons, army barracks and homes for the aged, homogenous groups of people take their food from a common kitchen.* The method of diet survey also is referred to as *inventory method.* The amounts of foods issued everyday as per the records are collected along with information on the number of individuals partaking in the meal. It is recommended that the inventory should be obtained for a period of at least one week. The average intake per person per day can be calculated as follows:

Average intake/person/day =

$$\frac{\text{Stocks at the beginning of the week} - \text{Stocks at the end of the week}}{\text{Total number of inmates} \times \text{Number of days of survey}} \quad (7)$$

The major limitations of this method are that the validity of the data depends on the accuracy of the records and any lapses in recording the issues could vitiate the results. The selection of the reference period should be random so as to avoid any manipulation of the records by the wardens. On a regular basis, we require information on dietary consumption of people at a country/regional level. For this, we use *food balance sheet.* Let *us* review what it is, next.

8.4.5 Food Balance Sheets (FBS)

The food balance sheet *is a method of indirectly estimating the amounts of food consumed by a country's population at a certain time.* It provides data on food availability or disappearance rather than actual consumption. Food and Agriculture Organization (FAO) of the United Nations compiles food balance sheets for different countries. These are prepared based on the assessment of the quantities of total food produced in the region/country, imports (if any), foods allocated for seed and industrial purpose, animal foods and wastage of foods (if any). The amounts arc divided by the mid year population of the region/country and 365 to derive average per capita consumption per day. Food balance sheets generally provide information as lo the foods available at the country level. The strength of this method is that it can give a total view of the food supplies of a country and can be used in drawing conclusions about food habits and dietary trends within a country. Food Balance Sheets are valuable for planning international nutrition policy and formulating food programmes. They are also useful for the administrators to monitor food position in the country. Food balance sheets also have some limitations. The accuracy of data is dependent upon available statistics, the quality of which can vary greatly depending upon a country's level of development. The data only represents the total amount of food reportedly available for consumption, not what was actually consumed, nor does it show how food was distributed among individuals or groups. Hence, they are of little use at the community level.

Thus you saw that there are different methods of assessment of dietary intake at various levels. The selection of the method of diet surveys depends upon the purpose, the group to be studied and the resources available.

With this, we end our study on dietary assessment. In the next unit, we will study about nutrition monitoring and surveillance.

Check Your Progress Exercise 3

1. Enumerate the common methods used to assess dietary intakes.

.....

.....

2. Answer these briefly:

   a. Strengths and limitations of 24-hour recall.

   .....

   .....

   b. Strengths and limitations of food frequency questionnaire.

   .....

   .....

3. Fill in the blanks:

   a) The results of family diet survey are expressed as ..... unit.

   b) The National Sample Survey Organization collects information related to consumer ..... on food every five years.

   c) The most common method to assess dietary intakes of individuals is .....

   d) ..... diet survey is used to assess dietary pattern of group of people living in an institution.

   e) Food balance sheets are useful to ..... the food position in the country.

8.5 LET US SUM UP

In this unit, we studied about the clinical assessment, biochemical assessment and dietary assessment, other than nutritional anthropometry, as the methods of direct nutritional assessment. We briefly reviewed the clinical signs of common nutrient deficiency disorders. For doing a biochemical test, we should have a knowledge of an ideal biochemical test, criteria to be used for selection of field test, precautions for doing the tests and importance of standardization of tests. We also learnt about the common methods used in dietary assessment. These are Family/Household survey which include Weighment diet survey and Consumption Expenditure survey; Individuals dietary assessment through 24 hour recall method, Diet record and Diet history; Qualitative survey; Institutional diet survey and Food Balance Sheets. We also learned that only trained people should carry out clinical, biochemical and dietary assessment.

8.6 GLOSSARY

Endemic : a disease that is constantly present to a greater or lesser degree in people of a certain class or in people living in a particular location.

Fontanelle : the soft spots on a baby's head where the bones of the skull have not fused together.

Hyperkeratotic lesion : a lesion formed from excess production of keratin in the skin.

Lancet : a surgical knife with a short, wide, pointed double-edged blade, used especially for making punctures and small incisions.

Sensitivity of a test : it is defined as the ability of a test to identify correctly all those who have the disease, that is "true positive".

Specificity of a test : it is defined as the ability of a test to identify correctly all those who do not have the disease, that is "true negatives".

8.7 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress Exercise 1

1. The other three methods of direct nutritional assessment in addition to nutritional anthropometry are clinical assessment, biochemical tests and dietary assessment.

2. Clinical assessment refers to looking for changes in the body e.g. eyes, hair, skin etc. and indicate nutritional deficiency.

3. The clinical signs of nutritional disorders

Nutritional disorders	Signs and symptoms
Kwashiorkor	• Oedema • Underweight (<80% of normal weight for age) • Apathy and irritability 4 Moon face • Hair and skin changes
Vitamin A deficiency	Changes in the eye such as • Conjunctival xerasis: dryness of the transparent membrane that covers the cornea and lines inside of the eyelid • Xeropthalmia (including keratomalacia): cornea becomes soft and raw and easily infected • Bitot's spot: dry foamy, triangular spots appearing on the temporal side of the eye • Nightblindness: inability to see in dim light
(Iron deficiency anaemia	• Paleness of conjunctiva, • Paleness of tongue • Paleness of mucosa of soft palate a Swelling of feet in severe anaemia • Spoon shaped nails
Iodine deficiency disorder	• Thyroid enlargement: gland visible and enlarged • Abortions, Congenital abnormalities, • Cretinism
Riboflavin deficiency	• Angular stomatitis- lesions on both angles of the mouth • Glossitis - Tongue bright red or magenta • Cheilosis - Lips become red and develop cracks
Niacin deficiency	• Dermatosis- Symmetrical skin lesions evident only on areas exposed to sunlight
Vitamin C deficiency	• Spongy bleeding gums
Rickets	• Changes in skeletal system- such as beading of ribs, pigeon chest: protruding breast bone, knock-knees or bow legs
Fluorosis	• Mottled teeth with chalky white and brownish areas with or without erosion of enamel

Check Your Progress Exercise 2

1. Biochemical assessment deals with measuring the level of essential dietary constituents (nutrient concentration, metabolites) in the body fluids (blood and urine normally) which is helpful in evaluating the possibility of malnutrition. An ideal biochemical test suitable for field survey should be sensitive (easily identify most positives), specific, easy to carry out, preferably non invasive and inexpensive.

2. 1-c; 2-d; **3-b;** 4-a; 5-f; 6-e

3. a) There are three methods to assess vitamin A deficiency. These include:

   i) Serum retinol method

   ii) Relative dose response method, and

   iii) Filter paper method

   i) In serum retinol method, vitamin A is regarded as public health problem in a community if serum vitamin A levels are <10 ygldl or <0.37 µmol/litre in more than 5% of children under the age of six years.

   ii) In the relative response method, increase (%) in serum vitamin A levels is measured after a small oral dose of 450-1000 µg of vitamin A. The post dose is inversely related to the vitamin A status of the individual. An increase >20% is indicative of vitamin A deficiency in an individual.

   iii) In the filter paper method, a blood spot is collected on a special filter paper and dried and carried to a laboratory for estimating serum retinol levels.

   b) Iodine deficiency is assessed by urinary iodine levels as these reflect the iodine status in a community. On adequate dietary iodine intakes, the median urinary iodine is 100 µg/L is considered as normal. In other words, in areas with adequate iodine intakes, in a half of the population urinary iodine level will be >100 µg/L. Similarly, if in >20% of the subjects, urinary iodine levels are < 50 µg/L the population is considered to be iadine'deficient.

Check Your Progress Exercise 3

1. The common methods used in dietary assessment are:

   a) Family/Household diet survey i.e. Weighment method and Consumption expenditure survey

   b. Assessment of dietary intake of individuals i.e. 24 hour recall method Diet record and Diet history method

   c. Qualitative survey

   d. Institutional diet survey, and

   e. Food Balance Sheets

2. a) Strengths and limitations of 24 hour recall: The strengths of 24 hour recall methods are that it is inexpensive and quick to administer (20 minutes or less) and can provide detailed information on specific foods. It requires only short term memory. It is well accepted by respondents because they are not asked to keep diet records and their expenditure of time and efforts is relatively low. The limitations include: Individuals may withhold or alter information about .what they ate due to poor memory or embarrassment or to please or impress the interviewer and researchers. Data on a single day's diet, are a very poor descriptor of an individual's usual nutrient intake because of day-to-day or intra individual variability.

b) Strengths and limitations of food frequency method: The strengths of food frequency questionnaire are that they are relatively inexpensive and quick to administer in large scale surveys. They are also considered one of the methods of choice for research on diet-disease relationships on both the macronutrient and micronutrient levels. The key limitation of food frequency questionnaire is that since the food list is limited to 100 or fewer foods and food groups, these must be representativeof the most common foods consumed by individuals in a sample.

3. a) consumption

b) expenditure

c) 24-hour recall

d) Institutional

e) monitor