1. Details of Module and its structure

Module Detail	
Subject Name	Food, Nutrition for Healthy Living
Course Name	Food, Nutrition for Healthy Living
Module Name/Title	Assessment of Nutritional Status - II
Module Id	FNHL_10103
Pre-requisites	General knowledge about nutritional status of individuals
Objectives	After going through this lesson, the learners will be able to do the following: ▪ Express the concept and importance of assessment of nutritional status. ▪ Identify the methods of nutritional assessment. ▪ Determine the meaning, advantages and limitations of Biochemical Assessment, Clinical Assessment, Dietary Assessment, Indirect Methods of Nutritional Status and its assessment
Keywords	Concept and importance of nutritional assessment, Methods of assessment, Biochemical Assessment, Clinical Assessment, Dietary Assessment, Indirect Methods of Nutritional Status

2. Development Team

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1. INTRODUCTION

In the previous module, you learnt about the importance of assessment of nutritional status and the methods that are used for assessment. You also learnt in detail about anthropometry which deals with measurement of the physical dimensions, proportions and gross composition of the body. It was also mentioned in the previous module that nutritional status can be assessed using clinical signs and symptoms, nutrient levels in body tissues and fluids, and food and nutrient intake of individuals. These are the clinical, biochemical and dietary methods of nutritional assessment respectively. You will learn about these methods in detail as well as mortality and morbidity rates etc., ecological and socioeconomic indicators which are the indirect methods of nutritional assessment in this module.

2. BIOCHEMICAL ASSESSMENT

Haemoglobin estimation in blood

This method of assessing nutritional status involves laboratory tests that measure the levels of nutrients and their metabolites in body tissues and fluids as these are a consequence of the variations in quantity and nutrient composition of food consumed and utilized by the body. Biochemical tests are sensitive to even small changes in nutritional intake and therefore, provide the earliest indication to malnutrition. Biochemical assessment also confirms clinical diagnosis of nutritional status and/ or risk for a disease. There are several biochemical tests that can be done on bones, hair, nails, subcutaneous fat, liver etc., however, in community settings most commonly, these tests are conducted on blood, urine and stool samples. For example, measuring haemoglobin (Hb) level in blood indicates iron deficiency anaemia. In adult males Hb level below 13g/100ml of blood and in adult females (non-pregnant and

non-lactating) below 12g/ 100ml blood indiactes anaemia. Similarly, severity of iodine deficiency in individuals can be assessed from the iodine concentration in their urine.The presence of worms such as round worm, hook worm etc. can be determined from the stool specimens of individuals.

Selection of biochemical test depends on the purpose and the availability of resources such as trained personnel, laboratory facilities and money etc. Proper collection, storage and transportation of blood/urine samples are extremely important for the accuracy of assessment. Moreover, reference values and cut-off points for levels of nutrients in body fluids/ tissues should be available for comparison and diagnostic purposes.

The following table gives some biochemical tests and the criteria (cut-off points) for deficiency of some nutrients and diagnostic criteria for some health problems.

Nutrient/ Health Problem	**Biochemical Test/ Parameter**	**Criterion for deficiency/ Diagnostic criterion**
Vitamin A	Serum vitamin A	< 20 mcg/dl
Vitamin C	Plasma Ascorbic Acid	< 3 mg/ L
Iron	Serum Iron	< 60 mcg/dl
Iodine	Urinary Iodine	< 100 mcg/L
Folic acid	Serum folate	< 6.0 ng/ml
Zinc	Plasma zinc	< 0.7 mg/L
Protein Energy Malnutrition	Serum Albumin	< 3.5 g/ dl
Diabetes	Fasting plasma glucose 2 – hour post load plasma glucose Glycosylated haemoglobin (HbA1C)	≥ 126 mg/dl ≥ 200 mg/dl ≥ 6.5%
Coronary Heart Disease	Total Cholestrol LDL Triglycerides HDL	> 200 mg/dl > 100 mg/dl > 150 mg/dl < 40 mg/dl

The advantages and limitations of biochemical method of nutritional assessment are:

Advantages:

- It can identify the nutritional problem in its earliest stage as biochemical changes occur before the appearance of clinical signs and symptoms.
- It is precise, accurate and reproducible.

- It is useful to correlate data obtained from other methods of nutritional assessment such as anthropometry, clinical signs etc. and gives clear confirmed picture of the nutritional problem.

Limitations:

- It can be time consuming.
- It is expensive and not suitable for large scale assessment.
- It requires trained personnel, laboratory facilities, etc.

3. CLINICAL ASSESSMENT

Clinical examination is the simplest and most practical method of ascertaining the nutritional status. It involves identification of signs that can be seen or felt in the superficial epithelial tissues, especially skin, eyes, hair and mouth; or in organs near the surface of the body such as thyroid and skull. These signs are indicative of inadequate or excessive nutrient intake.

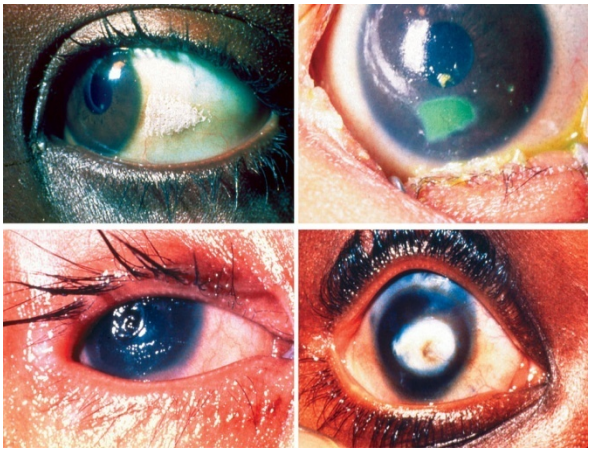
Following are some clinical signs of common nutritional problems:

Nutritional Problem (Deficiency/ Excess)	Clinical Signs
Kwashiorkor	Oedema, dyspigmentation of skin and hair, easy pluckability of hair, sparse hair, moon face, etc.
Marasmus	Extreme muscle wasting, loose and hanging skin folds, monkey face etc.
Vitamin A deficiency	Dry, foamy triangular spots on the conunctiva, dryness of conjunctiva and skin, dryness and ulceration of cornea etc.
Vitamin D deficiency	Bow legs, knock knees, beading of ribs, pigeon chest, enlargement of ends of long bones, etc.
Iron deficiency	Pale conjunctiva, tongue and skin; spoon shaped, paper thin, brittle nails; swelling in feet etc.
Iodine deficiency	Enlarged thyroid gland etc.
Fluorosis (Excess of fluorine)	Mottled (discoloured) and pitted dental enamel etc.

PICTURES OF CLINICAL SIGNS OF COMMON NUTRITIONAL PROBLEMS

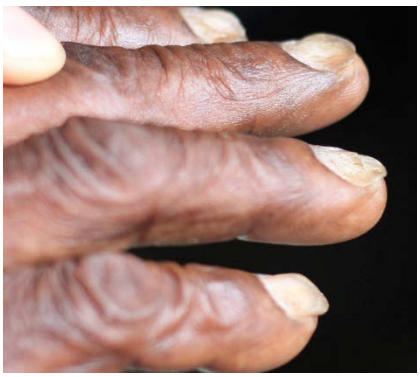
Kwashiorkor

Marasmus



Vitamin A deficiency

Vitamin D deficiency



Iron deficiency

Iodine deficiency

Fluorosis

Signs and symptoms of malnutrition are valuable aids in nutritional assessment. However, clinical assessment method also has some limitations.

Advantages:

- It is a quick method.
- It is an inexpensive method as elaborate equipment and laboratory facilities are not required.
- If appropriate training is given to junior personnel, village health workers (such as Anganwadi and ASHA workers), older children and parents; they can also identify some crucial clinical signs of malnutrition.
- This method gives an indication of the spread of malnutrition in an area/ selected population.

Limitations:

- Malnutrition is not detected in early stages as most of these clinical signs appear when the problem has become moderate to severe.
- Clinical signs alone often do not give a true picture of the problem and need to be correlated with the results of other methods of nutritional assessment because of the following reasons:
    - Sometimes non-nutritional environmental influences may be responsible for a clinical symptom but the symptom may be mistaken for a nutritional problem, e.g. cracking and bleeding from the angles of the mouth (angular stomatitis) which is a clinical sign of riboflavin (vitamin B_2) deficiency may occur due to excessive consumption of '*Paan*' which contains lime (*chuna*). Similarly, dryness of skin which is a clinical sign of vitamin A deficiency may also occur because of dry, windy climatic conditions. These may create a confusion about the actual cause of the clinical sign.
    - Almost all clinical signs that are observed also lack specificity. The same signs may be observed for different nutritional problems. For example, symptoms such as cracking at angles of mouth (angular stomatitis), cracking of lips (cheilosis), swollen red tongue (glossitis) may occur due to riboflavin as well as niacin deficiency.
    - A few clinical signs may be bidirectional, i.e. they may be seen in deficiency as well as excessive intake of nutrients. e.g. Dry rough skin may be observed both in case of deficient as well as excessive intake of vitamin A.

4. DIETARY ASSESSMENT

Diet determines the nutritional status of people and is a vital indicator of health. Hence, dietary assessment is conducted with the help of diet surveys which are systematic inquiries into the food supplies and food consumption of individuals and population groups. Information obtained from diet surveys helps not only in assessment of nutritional status but also helps in determining the relationship between nutrient intakes and deficiency diseases. However, accuracy and completeness of information gathered through diet surveys and availability of food composition database are of utmost importance and may pose as limitations of this method. Therefore, results of this method should be correlated with other methods of nutritional assessment to get a clearer picture of the nutritional status.

Several methods of dietary assessment are available and the same methods can be categorized in more than one of the following ways, such as:

1. Qualitative and quantitative methods
2. Retrospective and prospective methods
3. Family and Individual inquiry methods

Qualitative methods usually give information about food related behaviour. For example, food frequency questionnaires are used mainly for determining the frequency of consumption of different foods. Whereas, quantitative methods such as 24-hour diet recall is used to determine the amounts of different foods consumed in the previous 24 hours.

Retrospective methods such as 24-hour diet recall, diet history, food frequency questionnaire collect information about dietary intake in the past (generally the previous day) while prospective methods such as food records, weighment method, duplicate portion (chemical analysis) method collect information about current food intake of the day when the information is being gathered.

Inventory and Food list methods give information about the food intake of families, households or a group and methods like 24-hour diet recall, diet history, food frequency questionnaire, food records, chemical analysis of duplicate portion method etc. are used for dietary assessment of individuals.
Of the several methods of dietary assessment that are available, the most commonly used ones are the 24-hour recall method, Food Record method and the Food Frequency Questionnaire (FFQ) method. Let us now understand some important aspects of these two methods.

a. 24 hour diet recall method – In this method, the individual is asked to recall in as much detail as possible food and beverages consumed during the previous day at each meal and in between meals, however small quantity it may be. The individual is probed to give all details about food consumed like - what, how much, how it was prepared etc. and the information is noted by the investigator. Quantities are obtained from the individuals in household measures such as 1 small *katori*/ bowl, 1 big glass, 2 slices of bread etc. as they may not be able to give the quantities in grams or milliliters. Standardized utensils and food models appropriate for the local conditions may be shown to help individuals recall the amounts consumed.

24 HOUR DIET RECALL/ RECORD

Working Day

Meal & Menu	Quantity of each dish in Household measures (katories, glass – small, medium, large etc., number of chapatis, bread slices etc.)	Ingredients	Amount in Household measures (teaspoon, tablespoon, pieces, etc.)	Remarks		
				Thickness Consistency (like thin, medium, thick)	Greasiness (like low, moderate, high)	
Bed Tea 1. Tea	1 cup	Milk-toned Sugar	2 Tablespoon 1 teaspoon			
Breakfast 1. Milk 2. Aloo Parantha 3. Curd	1 small glass 1 medium 1 small katori	Milk –toned Sugar Wheat flour Potato Fat (Ghee) Curd (toned milk)	1 teaspoon 2 teaspoon		Moderate	
Mid morning 1. Coffee	1 cup (Nestle)	Milk-toned Sugar	4 tablespoon 2 teaspoon			
Lunch 1. Boiled rice 2. Rajmah curry 3. Salad	1 large katori 1 medium katori	Rice Rajmah Onion Fat (Groundnut oil) Cucumber Tomato	2 pieces 2 pieces	Medium consistency	Low	
Evening Tea 1. Coffee	1 cup	Milk-toned Sugar	4 tablespoon 2 teaspoon			
Dinner 1. Chapatis 2. Moong dal 3. Dry Potato vegetable	2 small 1 large katori ½ small katori	Whole wheat flour Ghee Moong dal (dehusked) Onion Ghee Potato Oil	½ teaspoon ½ teaspoon 1 small ½ teaspoon	Medium consistency	High	
Post Dinner 1. Milk	1 small glass	Milk-toned Sugar	1 teaspoon			

Sample Food Recall/Record

From the amounts of foods consumed by the individuals, nutritive value of each food consumed is calculated using the appropriate food composition database. In India, food composition database given by the Indian Council of Medical Research is used for this purpose (http://www.ninindia.org/ifct_2017.htm). Nutrient intake of individuals obtained from this method

is then compared with the recommended nutrient allowances given for their age, sex and activity level. Thus, a comparison can be made to assess the nutritional status of individuals. Normally, for better accuracy the diet recall should be repeated for at least 3 days, of which two should be working days and one should be a non-working day/ holiday like Sunday (this gives a variation in the weekly diet) to obtain the average usual intake of individuals.

There are several advantages and limitations of this method.

Advantages:

- It is inexpensive and quick to administer.
- It requires only short-term memory as the food eaten only on the previous day has to be recalled.
- It is well accepted by individuals as they are not required to keep a record of food consumed; and their expenditure of time and effort is also relatively low.
- It is useful for assessing average usual intakes of a large population.
- There is an element of surprise in this method and the individuals are therefore, less likely to deliberately modify their eating patterns.

Limitations:

- As the method relies on memory, it may not be suitable for elderly.
- Unless properly probed by the investigator, individuals may withhold or alter information about their food intake due to embarrassment or to impress the investigator.
- This method usually gives estimates of dietary intake rather than the actual intake.

b. Food Record method – This method is similar to the 24 hour recall method in the manner food consumption information of individuals is noted. However, the major difference is that the information here is noted by the individual himself as and when the food is being consumed, unlike the 24 hour recall method where the information is noted by the investigator for a previous day's consumption of the individual. The individuals may note the intake in terms of household measures or may actually weigh the amount of food consumed.The information using this method may be recorded for a period of 1 – 7 days. This method is also sometimes referred to as the Diary method. An advantage of this method is that it does not depend much on memory as the individuals record the information simultaneously at the time of consumption. However, this method can be used only for individuals who are literate and can record the intake themselves.

c. Food Frequency Questionnaire (FFQ): This method involves asking individuals how often or how many times (daily, weekly, monthly, etc.) they have consumed specific foods. The information may be recorded through interview or a self-administered questionnaire. The FFQ consists of two components – a food list and a frequency response section for individuals, as shown in the template. In the food list, the foods are usually grouped into categories based on the similarity of nutritive value, functions in the diet etc. This method provides only qualitative information such as food consumption pattern, dietary habits, food preferences of individuals etc.

This method can be used to get an idea about specific nutrient deficiencies in an individual if the food list contains items which are mainly good sources of a particular nutrient. For example, to get an idea about vitamin A deficiency in the individual, the food list should mainly contain foods sources of vitamin A and the individual's frequency of consumption of those items will indicate whether he is likely to have vitamin A deficiency. This method, however, can only give some indications which need to be confirmed using other more specific and accurate methods.

FOOD FREQUENCY QUESTIONAIRE

Instructions: Indicate how often you consume the following foodstuffs. Tick the relevant column.

Food item	Daily	2-3 times a week	Once a week	Once a month or less	Never
CEREALS					
Chapattis					
Paranthas					
Poori					
Porridge (Dalia)					
Rice/*pulao*					
Bread					
Noodles/pasta/macaroni					
Chirwa					
Oats/ Muesli/ Cornflakes					
PULSES					
Whole pulses					
Washed pulses					
Sprouted pulses					
VEGETABLES					
Green leafy					
Other vegetables					
Raw vegetables					
FRUITS					
Seasonal fruits					
Fruit desserts					
Fruit juices					
MILK AND MILK PRODUCTS					
Full cream milk					
Toned milk					
Skimmed milk					
Curd					
Paneer					

Sample Food Frequency Questionnaire

The **advantages** of FFQ method are:

- It is a simple and inexpensive method.
- It is quick to administer in large scale surveys.
- There is less burden on the respondents and therefore, it is well accepted by them.
- It is useful for cross validation of data obtained from 24 hour diet recall method.

- It is useful in cases where assessment regarding the status of a specific nutrient such as Iron or vitamin A deficiency etc. is required.

The **limitation** of this method is that it provides only qualitative information and its accuracy is lower as compared to other methods.

Let us now learn more about the indirect methods of assessing nutritional status.

5. INDIRECT METHODS OF NUTRITIONAL STATUS ASSESSMENT

As mentioned in the previous module, indirect methods use community health indices that reflect nutritional influences. These include the following:

1. vital and other health statistics,
2. ecological variables, and
3. socioeconomic variables.

These methods give important information about the nutritional status of both individuals as well as groups.

I. Vital and other health statistics: Morbidity refers to illness while mortality refers to death. Morbidity rates of many diseases, maternal and child mortality rates, life expectancy and other health statistics are affected by malnutrition.High mortality and morbidity rates indicate low levels of health and nutrition among the population. Hence, the study of these indirect indicators provides valuable information in nutritional assessment.

Some of the vital and other health indicators have been enumerated as follows:

i. **Crude death rate** is the number of deaths per 1000 population per year in a given community. A high death rate would indicate poor health status of individuals in the community.

ii. **Age-specific death/ mortality rates** refer to the number of deaths occuring in a specific age group of the population (for example 1 – 4 years) in a defined area during a specific period as the numerator. The denominator is per 1000 estimated total population of the same age group in the same area in the same period.

iii. **Infant mortality rate** is the number of deaths under 1 year of age in a given year to the total number of live births in the same year. This is expressed as per 1000 live births.

iv. **Under-5 mortality rate** refers to the proportion of total deaths occuring in children under the age of 5 years.
v. **Maternal mortality ratio** is the number of maternal deaths to per 100,000 live births in the same period.
vi. **Disease-specific morbidity and mortality rates** refer to the illnesses and deaths occurring due to a specified disease, such as Tuberculosis, diarrhoea, AIDS etc.
vii. **Life expectancy at birth** is the number of years a person who is born alive is expected to live if the current age-specific mortality rates persist.

Other health statistics such as attendance rates at out-patient departments of hospitals, duration of stay in hospitals, number of beds available in hospitals, prevalence of low birth weight (less than 2.5kg at birth) children; prevalence data for nutritional deficiencies such as anaemia, vitamin A deficiency, iodine deficiency etc. among the population; underweight, stunting, wasting among children; non-communicable diseases etc. – all provide information which is extremely useful for determing the nutritional status of people. This information can be obtained from the periodic surveys carried out by the government and International agencies such as WHO, UNICEF etc.

II. Ecological variables: Manutrition can occur due to the interaction between various environmental factors which include food production and availability, climatic conditions, environmental sanitation and hygiene, availability of eduactional and healthcare facilities, etc.

Food production may be majorly influenced by the geographical and climatic conditions in an area. If the food produced in an area is less, people there will face food shortage. If this condition persists for sometime, the people are likely to develop energy and nutrient deficiencies and may ultimately starve to death. Also, if there are natural disasters and emergency situations, food production and supply may be affected adversely resulting in increased malnutrition, morbidity and mortality.Food production and availability data gives vital clues to the kind of health problems that may occur in a particular area and the action that should be taken to prevent that.

Similarly, the level of environmental sanitation and hygiene in an area determines the communicable diseases and health issues the population living there may have. Communicable diseases such as diarrhoea, cholera, measles, tuberculosis etc. lead to increased malnutrition and mortality.

Availability of eduactional services in an area helps in determining whether people there would be aware enough to know what they need to eat and do to lead a healthy life. Lack of adequate educational and healthcare services predispose the population to adverse nutrition and health consequences. Hence, gathering and analysing data on ecological variables in an area provides useful information for determining the nutritional status of people in that area.

III. Socioeconomic variables: Magnitude of malnutrition is greater in populations that are socially and economically deprived. People who are poor have a low purchasing power. They are unable to meet their nutritional demands and also often live in conditions which do not have optimum hygiene and samitation levels. These conditions make them easy prey to various diseases and malnutrition. Even if people have enough food, sometimes due to customs, traditions, superstitions and beliefs, food distribution among the family members may not be appropriate. Females most often are discriminated and may not get enough food, and other eduactional and healthcare services. These conditions increase the extent of malnutrition among the females. As a consequence, the future generations are also affected because malnourished and uneducated females may not be able to follow optimum feeeding prcatices for their infants and young children. Therefore, information about various socioeconomic factors prevailing in the population such as poverty prevalence, employment rates, literacy rates, genderwise school enrolment and dropout rates, infant feeding practices etc. are also useful in assessment of nutrition status of individuals and groups.

Information on ecological and socioeconomic variables can be obtained from the official government records as well as other International agencies and non-governmental organizations that conduct surveys and gather such information periodically.

6. SUMMARY

In this and the previous module, you have learnt about anthropometry, biochemical, clinical and dietary methods of nutritional assessment. You now know the meaning, advantages and limitations of these methods in nutritional assessment and can choose the most appropriate method as per your requirements. You also know that indirect methods provide vital clues for nutritional assessment and should be used in combination with the direct methods, whenever required. Once you have been able to correctly assess the nutritional status of individuals/ groups, you need to take action to ensure that any malnutrition which exists is corrected as soon as possible. If some individuals/ groups are vulnerable and may suffer from malnutrition in the future, they should also be carefully monitored and their nutritional status should assessed regularly. Depending on the results of

nutritional assessment, different strategies such as food and nutrient supplementation, fortification, dietary diversification, providing appropriate healthcare services, nutrition and health education etc. should be used to prevent and manage malnutrition among individuals/ groups. Some of these strategies will be discussed in the subsequent modules that you will study.