UNIT 7 ASSESSMENT OF NUTRITIONAL STATUS IN COMMUNITY SETTINGS-I

Structure

7.1 INTRODUCTION

Earlier in Units 3 and 4, we have learnt about various nutritional problems prevalent in our community. It is important to know the extent and severity of these nutritional problems so that we can take appropriate steps towards eliminating these problems. The strategy to determine the extent and severity of nutritional problems is called *nutritional assessment* or *assessment of nutritional status. In* this unit and the next Unit 8, we are going to learn about different methods of nutritional assessment.

We have already learnt earlier that body weight is one of the most common indicators used to assess whether a particular individual is well nourished or not, Likewise, there are several other methods of measuring the nutritional status of the community. For example, in clinical practice, doctors identify children suffering from malnutrition by clinical examination. Some biochemical parameters like haemoglobin is estimated to assess the iron status among individuals. As a dietitian or nutritionist, you will be required to assess the dietary patterns of individuals or community groups as a means to assess nutritional status. Quite often, we also use certain vital health statistics like infant mortality rates, under 5 mortality rates to get a nutritional profile of our population. We shall learn about these methods i.e. anthropometrical, chemical, biochemical and diet survey in this unit and the next Unit 8. We shall start our study of nutritional assessment in this unit by focusing on nutritional anthropometry.

Objectives

After studying this unit, you will be able to:

- list goals and objectives of nutritional assessment,
- describe different methods of nutritional assessment,
- discuss indirect methods of nutritional assessment,
- explain the significance of nutritional anthropometry,
- discuss various methods of anthropometric classification, and
- carry out some of the nutritional anthropometric methods.

7.2 NUTRITIONAL ASSESSMENT-GOALS AND OBJECTIVES

We stated earlier that the strategy to determine the extent and severity of nutritional problems is called *nutritional assessment* or *assessment of nutritional status.* Before we discuss this further, let us first understand what we mean by the term nutritional status. *Nutritional status,* refers to the *state of health of an individual us it is affected by the intake and utilization of nutrients.* Thus, nutritional assessment is done to assess the severity and magnitude of nutritional problems prevalent in communities due to faulty intake or utilization of nutrients. The major objective of such an assessment is to determine the type (what'?), magnitude (the numbers affected) and distribution of malnutrition in different geographic areas (where?), identify the at-risk groups (who'?) and to determine the contributory factors (why?). In other words, the goal of the nutritional assessment of communities is to discover facts about nutritional situation and guide action to iinprove nutrition and health. Factual evidence of the exact magnitude of nutritional problems is essential to sensitize administrators and politicians to obtain allocation of material and human resources and plan appropriate intervention strategies. Also, in the formulation of a public health strategy to combat malnutrition, assessment of nutritional status of community is the first step. There are different methods of measuring nutritional status. Let us study what they are?

7.3 METHODS OF NUTRITIONAL ASSESSMENT

In our discussion so far we have studied as to why we do nutritional assessment. Next, let us get to know how we do nutritional assessment. There are certain methods which are used to conduct nutritional assessment. These methods can be categorized as *Direct Assessment* and *Indirect Assessment.* We would learn about both these methods in this section. Let us study about direct assessment first.

1. Direct Assessment

In direct assessment, we measure certain indicators on representative samples of community to determine nutritional status of community. In other words, we can directly take measurements like body weight or clinically examine or estimate haemoglobin levels on certain group of individuals. The representative samples of community can be taken with the help of nutrition survey. We will study about different methods of direct nutritional assessment a little later in this unit. Let us now look at Indirect assessment.

2. Indirect Assessment

Under the method of Indirect assessment, a variety of vital statistics are used to assess nutritional status. These are: 1) mortality rates among vulnerable groups of population

like infant mortality sate or maternal mortality rate, and 2) morbidity rates of conditions like diarrhoea and respiratory infections etc. to find out whether the community is adequately nourished or not.

We will begin our discussion on methods of nutritional assessment by first learning in detail about indirect assessment and review some specific health statistics data used under this method to assess nutritional status of community. We will then go over to study about direct assessment. So then, let us get started with indirect assessment.

7.4 INDIRECT ASSESSMENT OF NUTRITIONAL STATUS

Nutritional status, we have learnt above, can be assessed by indi ect methods such as mo tality rates (i.e infant, maternal and perinatal mortality rates), morbidity rates and other health statistics. Let us understand what we mean by mortality and morbidity rates. Mortality rate is defined as *the number of deaths in a group* of *people, usually expressed as deaths per thousand* while morbidity rate *is defined as tlze number of people* ill *during a time yeriod divided by the number of people in the total population.* You may recall learning about these statistics in the previous Unit 6 in section 6.5. Generally, in such cases, data already collected in connection with other national surveys is utilized for the purpose. The principle is that malnutrition influences several morbidity rates and mortality rates. In addition, morbidity rates also influence the nutritional status of vulnerable groups of population particularly young children.

It should be recognized that quite often collection of accurate data on these rates is often beset with a lot of problems. Only institutions having sufficient expertize should collect such data. In India, *sample registration scheme* collects information regularly using standardized procedures through trained investigators on statistically adequate samples. They publish annual reports, which could be used for the purpose. Collection of morbidity data requires prospective surveys on a statistically adequate sample using standardized definitions and procedures. Morbidity surveys involve collection of data on a longitudinal basis by visiting the selected households either weekly or at least fortnightly. The gap between two visits in a morbidity survey is called as *reference period.* It is recommended that this should never be more than a fortnight. Longer the gap, more will be the recall lapse by the persons providing information. Morbidities like diarrhoea, acute respiratory infections and measles are commonly associated with malnutrition. Higher incidence of these morbidities could be considered to lead to malnutrition. In addition, malnutrition could predispose to some of these morbidities, as the child's immunity (ability to fight infections) would have been affected during severe malnutrition. Some of the specific indirect indicators used to asses nutritional status of community are: age-specific mortality rates, cause specific mortality rates and cause specific morbidity rates. Many times, data is also collected on ecological factors which affect nutritional status of community. Let us study each of these indicators in detail. We shall start with the mortality indicators first.

7.4.1 Age Specific Mortality Rates

An age-specific mortality rate is a mortality rate limited to a particula age group. The numerator is the number of deaths in that age group, the denominator is the number of persons in that age group in the population. Age specific mortality rate is an important indicator of health status. In areas, where the prevalence of protein energy malnutrition is high, mortality among children between 1-4 years remains high. Though infant mortality rate (IMR) is considered as an indicator of health status, it is now recognized that the 1-4 year mortality rate is several folds higher in developing countries compared to developed countries due to high rates of protein energy malnutrition.

This is also evident by the fact that since independence there has been a considerable reduction in IMR (from about 160 to 60 per 1000 live births). The main reason for the high mortality among children 1-4 years is due to the combined effect of nutritional stress and high morbidity rates during this age period.

Now, where can we collect the data on age specific mortality rates?

We can collect this data by consulting birth and death records, wherever available. In India, *census data* collected regularly every decade can also provide such information. Special surveys could also be organized if necessary expertise is available on statistically adequate and random samples. However, such surveys are laborious 'and time consuming and may not provide any additional information over direct methods of assessment. Let us look at the second indicator now. i.e. cause specific mortality.

7.4.2 Cause Specific Mortality Rates

The cause-specific mortality rate is the mortality rate from a specified cause for a population. The numerator is the number of deaths attributed to a specific cause. The denominator is the at risk population size at the midpoint of the time period.

Data on cause-specific mortality would be extremely useful to determine the nutritional status of communities indirecllly. However, in India, such data is not available in all the areas and most often is not accurate. Such data can be obtained from health centers and hospitals. Mortality due to clinically identifiable malnutrition, if records are available, could be of help to assess indirectly the nutritional status of communities. Hospital admissions of clinical cases of nutritional deficiencies, particularly of severe protein energy malnutrition and keratomalacia, also are often used as an indicator of nutritional status of communities.

We looked at the indicators related to mortality. Now let us look at the indicator on morbidity i.e. disease.

7.4.3 Cause Specific Nutritionally - Relevant Morbidity Rate

Information on the prevalence/incidence of nutritionally relevant diseases like measles, diarrhoeas and acute respiratory infections also are indirect indices of nutritional status at the community level. In clinical settings, most often children with severe forms of clinical malnutrition have a history of suffering from some of these morbidities before developing malnutrition. In fact, in the earlier days, epidemics of malnutrition followed epidemics of measles and diasrhoeas. There are other diseases which alsa contribute to malnutrition. Some of these are intestinal helminthiasis, malaria and tuberculosis. These could also influence the extent of malnutrition in a community. In the present circumstances, the occurrence of AIDS could be an important determinant of malnutrition.

Therefore, during the field visits, information on these diseases could be obtained from hospitals and health centers. The cause specific nutritionally relevant morbidity rates, therefore, serve as an important indirect indicator to assess nutritional status. Let us now study about some ecological factors which could indirectly indicate the possible nutrilional status of communities.

7.4.4 Ecological Factors

Human malnutrition is recognized to be an ecological problem in the sense that it is the end result of several overlapping and interacting factors in the community's physical, biological and cultural environment. Information on food consumption, particularly infant and child weaning practices, beliefs and cultural practices, medical and health services; educational services and socioeconomic conditions of the community will be of use in the assessment of nutritional status at the community level. We can collect the information through field visits to the areas. Let us study about some of these factors in a little detail to see how they could affect malnutrition.

- *Breastfeeding and Complementary feeding*

Breastfeeding practices like exclusive breast feeding up to 6 months of age, feeding of colostrums to newborn children and introduction of complementary food at six months of age to infants are the most important factors which could improve the nutritional status of communities. In India, where the prevalence of malnutrition continues to be high, colostrum is often discarded due to certain taboos (it is impure milk), complementary food is introduced only after the child completes the age of one year. In other words, the child is not getting adequate food even from a very young age.

- *Food Consumption Practices*

Similarly, qualitative information on food consumption could be an indirect evidence for malnutrition in that community. For example, the practice of consumption of foods like pulses, green leafy vegetables and milk particularly among young children can indicate the state of nutrition of the community. In addition, the practice of reducing food intakes and avoidance of foods during pregnancy, restriction of foods during certain diseases like during diarrhoea is indicator of poor dietary practices among the community.

- *Socioeconomic Factors*

Socioeconomic status determines nutritional status. Malnutrition is of higher magnitude among the poorer groups like scheduled caste and tribe communities people living in urban slums etc. Apart from poverty, the literacy - particularly female literacy - among these communities is very low leading to ignorance and food taboos. The living conditions of these groups is so poor that even if they spend all their incomes on foods, they still will not be able to meet the nutritional needs. The gender discrimination, particularly at the social level, could contribute to higher malnutrition among females.

- *Health Care Facilities and Practices*

The health care facilities as such in the rural areas are not satisfactory and even if they are available the community most often visits these facilities at a late stage. Most often, any visit to a health facility, which is situated at some distance means loss of wages for the household. In addition, the services are not satisfactory due to lack of accountability among the health functionaries. Assessment of environmental sanitation and hygiene practices also could indirectly indicate the possible nutritional status of communities. The information on these factors can be collected through rapid visits and collection of qualitative data.

From our above discussions, it is clear that factors such as feeding practices, food consumption patterns, socioeconomic factors and health care practices, can all influence' nutritional status. Remember all these factors are indirect assessment methods,

Thus we saw that we could use health statistics data and also collect information on ecological factors to indirectly assess nutritional status of community. We will now study how we could directly assess the nutritional status of the community, But first let us recapitulate what we have learnt so far. Answer the check your progress exercise 1 given next.

Check Your Progress Exercise 1

1. Mention three main purpose of nutritional assessment.

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2. What are the different methods of nutritional assessment?

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3. List three health statistics data used for indirect nutritional assessment.

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4. List three ecological factors used for nutritional assessment.

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Now we move on the direct assessment of nutritional status.

7.5 DIRECT ASSESSMENT OF NUTRITIONAL STATUS

The last section focused on indirect assessment techniques of assessing nutritional status. We have also studied earlier that we can also directly assess nutritional status of community. We can directly reach out to the people and conduct nutritional assessment. How? We can do it in many ways. For example, we can ask people about their dietary intake, we can take their body measurement or conduct some biochemical tests. The commonly used methods are:

i. Nutritional anthropometry,

ii. Clinical examination for nutritional signs,

iii. Biochemical estimation, and

iv Dietary assessment.

In this unit, we will learn about the first commonly used method of assessment i.e. nutritional anthropometry in detail. About other methods, we will learn in the next unit i.e. Unit 8.

We stated in the beginning of this unit that we measure certain indicators on representative samples of community to assess the nutritional status of communities and these representative samples can be taken with the help of a nutrition survey. In the routine nutrition surveys, clinical examination and nutritional anthropometry form the most important components, since these are relatively simple in community situations and do not require any sophisticated equipment like biochemical estimations.

Before we discuss in detail about the different methods of direct assessment of nutritional status of community, let us learn as to how nutritional deficiency progresses, which would help us to decide the methods of assessment to be adopted to measure/ identify these changes.

Progression of Nutrition Deficiency ***Disorder***

It is well recognized that the primary cause for nutritional. deficiencies is inadequate dietary intakes for long periods. Such a dietary inadequacy, to start with, leads to changes in tissues and organs like muscles and liver progressing subsequently to biochemical changes, While the changes in tissues can be measured by examining the concerned tissues, examination of the blood and plasma or serum can identify biochemical changes. At this stage, the nutritional deficiencies are considered as ***sub-clinical*** as we cannot find any anatomical changes by naked eye examination. These sub clinical changes can be identified either by biochemical assessment or anthropometry, The anatomical changes in some of the organs of the body, like swelling in the body or changes in the eyes, can be diagnosed by clinical examination. Table 7.1 gives a **flow** chart indicating methods of assessment to be used as the nutrition deficiency progresses. It depicts that by conducting a dietary survey, we can assess dietary inadequacy and

as the deficiency progresses, different methods of assessment will indicate changes at different levels in the body.

Table 7.1: Progression of nutrition deficiency disorder

Progressive of Deficiency		Methods **of** Assessment
Dietary Tnadequacy	→	Diet Survey
Tissue Changes	→	Examination of Tissues
Biochemical Changes	→	Biochemical assessment
Sub clinical changes	→	Anthropometry
Anatomical Changes	→	Clinical Examination

It is important to recognize that the clinically diagnosable forms of nutritional deficiencies represent only the tip of the iceberg, the bulk of which is under water and is not visible. It is estimated that for every case of clinical form of protein energy malnutrition (kwashiorkor/marasmus), there are at least 5-6 cases of moderate to severe undernutrition. Thus, clinical examination measures only a small proportion of nutritional disorders and, therefore, other methods of assessment should be simultaneously used to determine the real magnitude of nutritional deficiencies. This is important not only to sensitize policy makers and administrators regarding the importance of malnutrition but also to plan the requirements for any intervention programmes.

With this basic understanding of the progression of nutritional disorders, let us now learn what is nutritional anthropometry? What are its uses and what are the common measurements used in nutritional anthropometry?

7.6 NUTRITIONAL ANTHROPOMETRY

One of the most important physical changes that occur in undernutrition is growth retardation. Nutritional anthropometry is the tool ***which*** *con assess even the early changes in growth failure.*

What is nutritional anthropometry? Nutritional anthropornetry is *measurement of human* body *at various ages and levels of nutritional status.* It is based on the concept that an appropriate body measurement reflects any morphological variation occurring due to a significant functional physiological change. It is an important component of any nutrition survey because it is simple, easily measurable by workers with limited educational qualifications and provides as much information on the nutritional status of individuals as biochemical parameters. What are the uses of anthropometry? Let us read and find out in the next sub-section.

7.6.1 Uses of Anthropometry

Nutritional anthropometry is a very useful tool. It helps in:

1. assessment of extent of undernutrition of vulnerable groups of population,
2. monitoring of individual children at regular intervals (monthly or quarterly) to find out faltering in growth (deterioration/no change of growth) to help in early detection and initiating prompt remedial measures,
3. identification of children who are at risk of undernutrition, to target and prioritize nutrition action programmes so as to control the extent of undernutrition,
4. mid-term appraisal or terminal evaluation to assess whether intervention programmes have achieved the objectives, and
5. assessing nutrition rehabilitation of malnourished children under treatment.

Having gone through the points above you would now realize how important nutritional anthropometry is. We will now study about various body measurements used in nutritional anthropometry and how they are used in determining the nutritional status.

7.6.2 Common Measurements Used in Nutritional Anthropometry

The methods of the body measurement, you must realize, should be simple and provide practical information on community. These should be quick to measure, and the easiest to reproduce, simultaneously providing maximum information concerning a number of nutritional problems. The most commonly used measurements in routine surveys are:

1) Body weight,
2) Standing height or Crown-heel length,
3) Mid-upper arm circumference, and
4) Body Fat.

Circumference of head and chest are also included in some surveys covering children less than five years of age. However, in view of their limited usefulness we will discuss only the four measurements mentioned above. You will now learn the relevance of the body measurements and the methods of their measurement. Let us start with the first measurement, that is, body weight.

1) Body Weight

Body weight is the most widely used and the simplest reproducible anthropometric measurement for the evaluation of nutritional status of individuals. Why ? Let's find out.

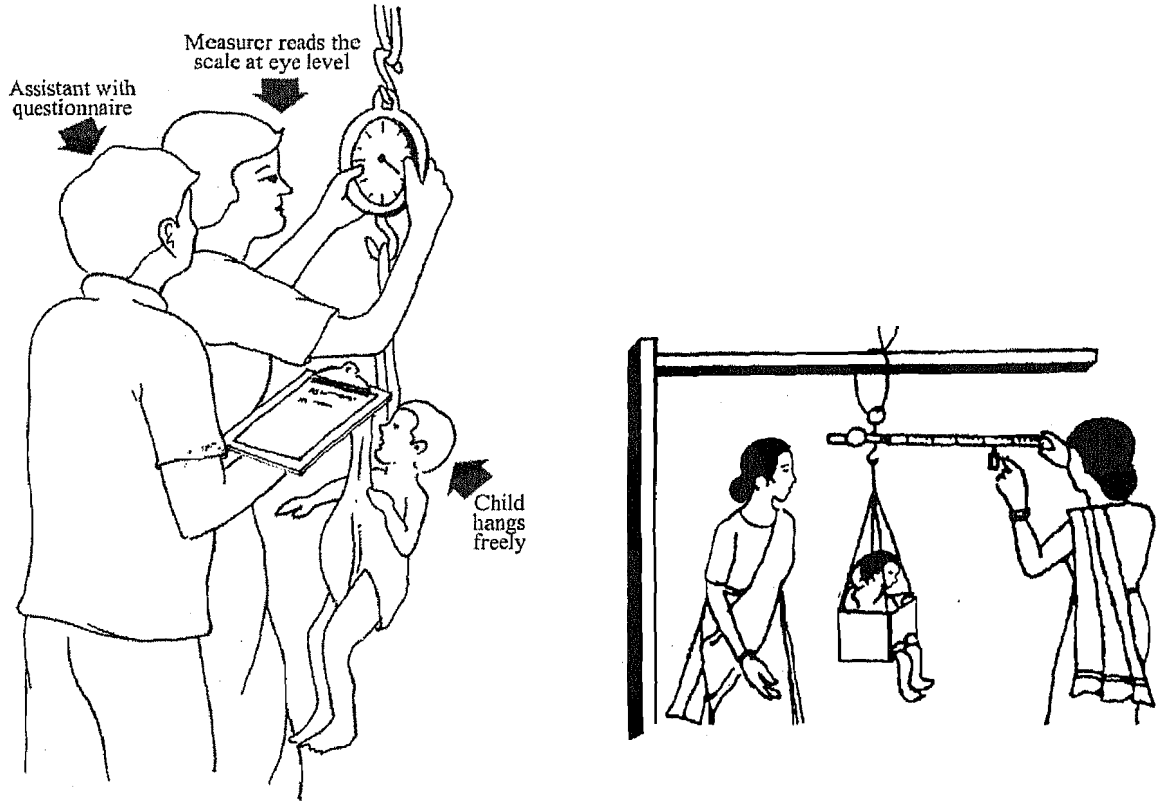
Why body weight?

Body weight is a composite of all body constituents like body water, minerals, fat, protein, bone etc and indicates the body mass. One of the advantages of body weight is that its utility is perceived not only by the health personnel, but also by the community, both the educated and illitel-ate alike. It is not uncommon to find several mothers approaching doctors either because their children weigh less (in their perception) or are losing weight. Thus, it is easier for the health professionals to provide education 'to women about the need for proper nutrition by comparing body weights vis á vis the normal weights. Serial measurements (repeated measurements at regular periods) of weight, as in growth monitoring, are more sensitive indicators of changes in nutritional status than a single measurement at a point of time. *Growth monitoring, as you may*

be aware, refers to the regular measurement of growth which enables mothers to visualize growth, or lack of it, and obtain specific relevant and practical guidance to ensure continued regular growth and health of children. Body weight is sensitive even to small changes in nutritional status, caused by short duration childhood morbidities like diarrhoea etc. Rapid loss of body weight in children should be considered an indicator of potential malnutrition. Weight is indicative of short-tern1 malnutrition. On the other hand, weight may also be fairly quickly regained after appropriate intervention. Thus, body weight is also a good indicator of nutritional rehabilitation.

How do we measure body weight?

The choice of suitable weighing scales is very important to obtain accurate measuretnents of body weight. Two types of weighing instruments are available. These are 1) Salter Weighing scale, which is a spring balance, and 2) Beam or lever scales as shown in Figure 7.1 (a) and 7.1 (b), respectively. Salter weighing scale is light and portable and can be hung from a roof or a tree as shown in the Figure 7.1 (a). The child is placed in the sling and then the weight is recorded.



(a) Salter Scale **(b) Beam Scale**

Figure 7.1 : Weighing scale

Beam or lever scales with an accuracy of *50* g or 100 g are preferable for taking body weight, as they are more accurate. In the case of birth weight the accuracy should be at *20* g. The commonly used 'bathroom type' weighing scales are spring balances. These ase not recommended as the springs get stretched and inaccurate from frequent use. **A** comparative study of spring type and lever actuated weighing scales indicated considerable differences in weights. The errors in measurements using bathroom scales ase quite high ranging between *0.5* to 1.5 kg in young children between 1-5 years of age. Beam balances are manufactured in India and have been found to be reliable and are currently in extensive use in ICDS projects. However, it should be recognized that all the weighing scales are tested for accuracy with known standard weights at regular intervals and put out of use as soon as the accuracy is lost. -Let us get to know about the technique of taking weight.

Technique

Weights should be taken as far as possible with minimal clothing, without shoes and without hoiding any support (in case of children they will be holding the hands of one of their parents/relatives). In the case of infants and noncoperative children, the weights could be taken with an elder person carrying the infant/child (usually the mother1 caretaker)and subtracting the weight of the elder to get correct weight. In cold places, the subjects may be wearing heavy warm clothing as a protection against cold. In such situations, an average weight of the warm clothing can be obtained which can be subtracted from the weight of the individual.

Let us go over to the second method i.e. height.

2) Height

Length or height is a very reliable measure that reflects the total increase in size of the individual up to the moment it is determined. Let us find out why height is used as an important measure to assess nutritional status.

Why Height?

The height of an individual is influenced both by genetic (hereditary) and environmental factors. An individual's maximum growth potential is determined by hereditary factors (parent's height). The environmental factors, the most important being nutrition and morbidity, determine the extent of exploitation of that genetic potential. In other words, only when there is appropriate environment - optimal nutrition and good health care - an individual can achieve his/her maximum height. Inadequate dietary intake and/or infections reduce nutrient availability resulting in growth retardation. During periods of severe nutritional deprivation, growth of height slows down leading to stunting (short stature) in an individual. Thus, stunting is a consequence of chronic food deficiency. Since height is affected only by long-term nutritional. deprivation, it is considered an indicator of chronic or long-duration malnutrition.

Next, let us learn about the techniques used for height measurement.

Technique

Standing height is measured by anthropometer rods, which are four-piece chromium plated portable metal rods with a headpiece with an accuracy of 0.1 cm. Some companies in Delhi and Hyderabad make such anthsopometer rods. A vertical measuring rod or a wooden scale with accurate divisions could also be used. Figure 7.2 shows the instrument for taking standing height of children.

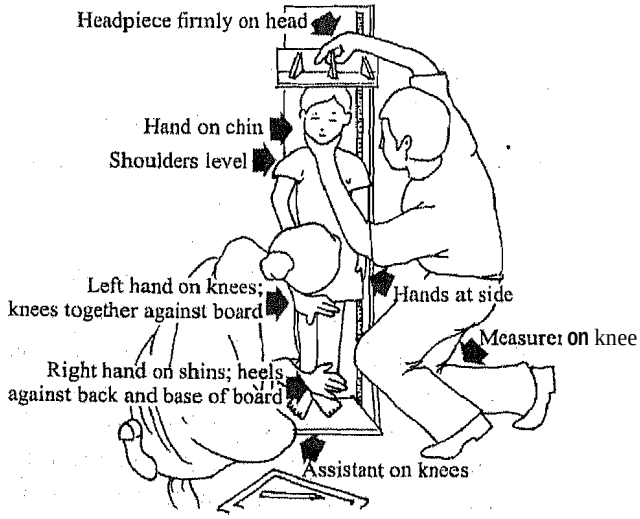


Figure 7.2: Child height measurement

Height is taken without shoes with the subject standing erect on a flat surface or the platform of the weighing scales, with the arms hanging naturally at the sides. The head should be held comfortably erect, with the lower border of the eye orbit in the same horizontal plane as the external auditory meatus (hole of the ear). The headpiece of the anthropometer rod should be held, without much pressure, in the sagittal plane (central part of head).

In the case of infants and young children who cannot stand or those who do not cooperate, the height is measured with an *infantomter*. This is referred to as *recumbent* or *crown-heel length,* which is taken on children below the age of 24 months. Figure 7.3 shows the *infantometer* for taking recumbent length of the children.

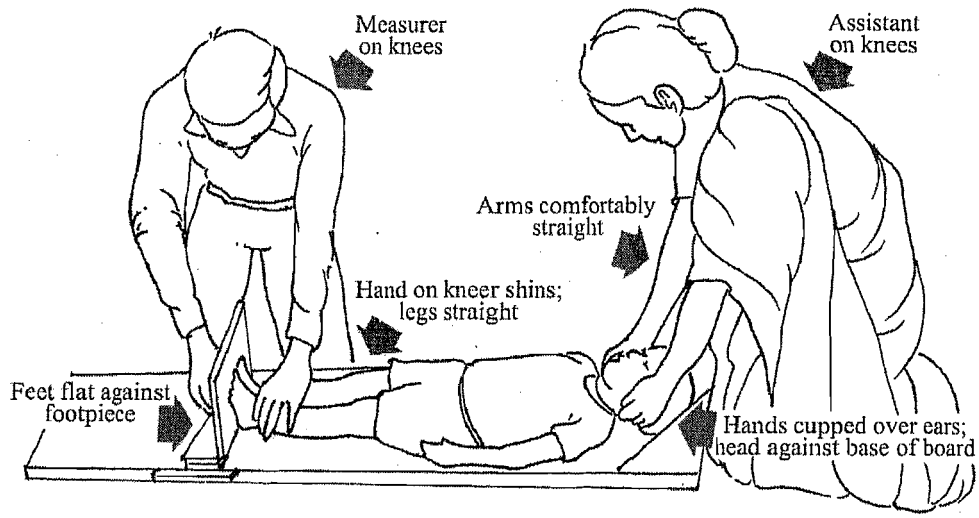


Figure 7.3: Child length measurement

The child should be laid on the infantometer board with his head touching the fixed headpiece. An assistant should hold the child's head in proper position. The investigator should ensure that the child's body is straight, and flat; should press the knees and ankles flat against the board and bring the movable piece of the board flat against the heels with optimum pressure. The measurement should be read while child is still in position. It is generally agreed that recumbent length measurements are greater than stature measurements.

Let us now go over to the third method i.e. mid-upper arm circumference as a measurement used in nutritional anthropometry.

3) Mid-Upper Arm Circumference (MUAC)

Mid upper arm circumference is a useful indicator of nutritional status of individuals and cominunities. How does this measure reflect the nutritional status? Let us find that out.

Why Mid-Upper Arm Circunzference?

Poor musculature and wasting are cardinal features of moderate and severe protein energy malnutrition in early childhood. Circumferences of mid-upper arm (MUAC) and calf are recognized to inclicate the status of muscle development in the body. The mid-upper arm is heavily muscled and approximately circular. The mid-upper arm circumference is considered more feasible as it is easily accessible in any age and sex, and so is simpler and practical to measure. The MUAC may be useful not only in identifying malnutrition but also in determining the mortality risk in children. The tneasurements of MUAC correlate well with weight, weight for height and clinical

signs of PEM. When measured along with fat fold at triceps, MUAC, in addition, can be used to calculate mid arm muscle circumference (fat free arm circumference). The assumption is that the cross-section of the mid upper arm circumference approximates a circle, and that the adipose tissue (fat) is evenly distributed around the area. Let us learn about the technique next.

Technique

The arm circumference is measured with flexible fibre glass tape up to 0.1 cm. It is taken on the left arm, while hanging freely by the side, at its mid point. The mid point of the left upper arm is measured by taking first the length of the upper arm - between acromion process of scapula and the tip of ulna- by flexing the forearm at right angles. The mid point is marlted at half the length with a skin rnarlting pencil/ball pen. The fiberglass tape is placed at the mid point gently but firmly without disturbing the contours of the arm in any way. Figure 7.4 gives arm circumference insertion tape and correct tape position for arm circumference.

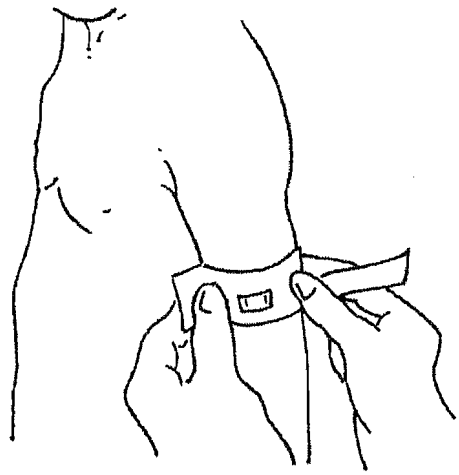


Figure 7.4: Measurement of mid upper arm circumference

Let us go to the fourth method of body measurement i.e. body fat

4) Body Fat

The adipose tissue is distributed over a large number of sites in the body. Subcutaneous fat constitutes the body's main store of energy (calorie) reserves. How does the measure of subcutaneous fat, then reflect the nutritional status. Let us find out next.

Why measure fat?

Close association has been observed between fatness and calorie reserves, and between muscularity and protein status. This relationship can be used as a tool for assessing the gross nutritional status of persons at specific stages of life. Usually, in field circumstances, measurement of fat fold thickness at different sites is more feasible than the sophisticated densitometry or underwater weighing etc. The thickness of fat at various sites of the body has good correlation with measures of body fat as determined by autopsy, densitometry and radiography. Fat distribution in and around the body varies with age, sex, physiological, nutritional and health status and ethnicity. Of all the measures of fatness, fat fold at triceps is considered to be the simplest and most feasible in community surveys. In addition, fat folds are measured at subscapular and supreiliac regions. Let us learn about the technique of fat measurement next.

Technique

Fat fold at triceps is taken at the same point where mid upper arm circumference is taken. Skinfold calipers like the one shown in Figure 7.5 is used to measure skinfold thickness.

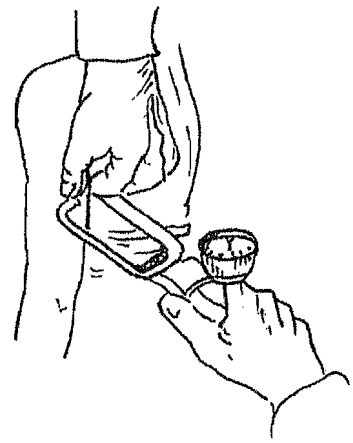


Figure 7.5: Measurement of fat fold using skinfold calipers

Various types of skin fold calipers (Harpenden/Lange skin fold calipers) are available in the market. These are mostly imported. One of the important factors to be conside ed while selecting the calipers is that the pinch area should be 20-40 mm^2 with an accuracy of 0.1 inm and should exert a constant pressure of about 10 g/ mm^2 The fat fold measured consists of a double layer of skin and fat. The measurement is made with the arm hanging loosely by the side. The Eat fold parallel to the long axis is picked up between thumb and fore finger of the left hand without including any underlying muscle and the measurement taken with the calipers. An average of three measurements is recommended.

Now that we have learnt about how to take the correct body measurements, we should find out how we can assess nutritional status with these measurements. Before we move on to this topic, let us review what we have learnt so far, by answering the questions given in check your progress exercise 2.

Check Your Progress Exercise 2

1. Mention various methods of direct assessment of nutritional status.

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2. List four uses of anthropometry.

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3. What are the common measureinents used in nutritional anthropometry?

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Now, first, we would learn how to assess nutritional status in individuals {includes children an adults), then we will learn how to assess nutritional status in community.

7.7 METHODS OF ASSESSING NUTRITIONAL STATUS IN INDIVIDUALS

Before we learn about how to assess nutritional status in individuals and community, there are two more important aspects which we need to consider. These are *correct age of the child* and the *growth reference values.* Accurate age of the child should be assessed for comparison with known growth standards, which can only help in the diagnosis of undernutrition. Let us learn about how we can assess the correct age of the child and how do we select the growth reference values for comparison.

• Age Assessment

You probably know that persons living in the rural area and urban slums in India often are ignorant of their accurate age. More exact assessment of age (up to the month, if possible) is required particularly in children to assess protein energy malnutrition. Only a few can produce documentary evidence like either birth certificates or horoscopes. However, in India, fortunately the age assessment can be done fairly accurately with the help of a calendar based on local events. In India, several festivals take place almost every month. In the villages, the farmers also remember lunar months or the periods of sowing or harvesting of different crops. Before undertaking any nutrition survey therefore, a calendar of festivals and other events that have occurred during the previous 5-6 years is prepared and used to assess the age of children. The mother is asked to relate the birth of her child to one of the festivals or important local events, and the number of such events the child would have celebrated since birth is determined. With the help of such a calendar of local events, it is possible to assess the age fairly accurately. The age of older children is assessed in relation to the age of the younger child. The mother will be able to tell as to how old was the elder child when the younger child was born. In areas where the gap between children is so small, it is often not difficult to assess the age of older children, at least in terms of completed years.

• Growth Standards

Once we have taken the weight and height of the children and assessed the correct age, we would want to compare these with a standard called reference data sets so that we are able to assess the grade or extent of malnutrition. These standards also known as "frame of reference" are obtained by measuring cross-sectionally (at one point of time) a statistically adequate sample of healthy and well-fed children of various ages, whose ages are known accurately. It is recommended that these be based on normal children, as defined above, of the same area. It would be ideal to have our own local standards, but, constructing tables of local standards is logistically time consuming requiring both human and capital resources. Therefore, what we use are the standards developed by a US agency-National Center for Health Statistics (NCHS). Surveys in different countries have revealed that heights and weights of well nourished young children from developing countries are very much comparable to those of American children as shown by data collected by the National Center for Health Statistics. In fact, during the preadolescence phase, environmental factors (including nutrition) play a dominant role in deciding the growth of children. Hence, the World Health Organization recommends the use of NCHS standards all over the world to assess the extent of undernutrition. These are also referred to as *international standards,* You should also be familiar with the concept of percentiles before you use the growth charts. Percentile is *the numerical value of a child in a series of hundred children arranged in an ascending order.* In other words, 50th percentile is the value of the fiftieth child in such a series and is also known as median. Equal

number of children will be either above or below the 50th percentile. Similarly 10th percentile means that 10 percent of children are below the value and 90% are above this value.

Table 7.2 gives the median values (or 50th percentile values) for height and weight as given by NCHS.

Table 7.2: Weights and Weights of boys and girls (0-60 months) — NCHS Median values

Age (Months)	Boys		Girls	
	Height (cms)	Weight (kg)	Height (cms)	Weight (kg)
0	50.5	3.3	49.9	3.2
3	61.1	6.0	59.5	5.4
6	67.8	7.8	65.9	7.2
9	72.3	9.2	70.4	8.9
12	76.1	10.2	74.3	9.5
15	79.4	10.9	77.8	10.2
18	82.4	11.5	80.9	10.8
21	85.1	12.0	83.8	11.5
24	87.6	12.3	86.5	11.8
27	88.1	12.9	87.0	12.4
30	90.4	13.5	89.5	13.0
33	92.7	14.1	91.7	13.6
36	94.9	14.6	93.9	14.1
39	97.0	15.2	96.0	14.6
42	99.1	15.7	97.9	15.1
45	101.0	16.2	99.8	15.5
48	102.9	16.7	101.6	16.0
51	104.8	17.2	103.4	16.4
54	106.6	17.7	105.1	16.8
57	108.3	18.2	106.7	17.2
60	109.9	18.7	108.4	17.7

Source: *Measuring chnnge in nutritional status. Guidelines for assessing the nutritional impact of supplementary feeding programmes for vulnerable groups. WHO, Geneva, 1983.*

We can express the weight and height of children as % of NCHS values. For example, if we have a 18 month old girl weighing 8.5 kg, and if we want to express her weight as % of NCHS values. Then first we will find out the NCHS median weight for a 18 month old girl from the Table 7.2. The reference median weight as you can see in Table 7.2 for 18 months old girl is 10.8 kg. Thus, the weight of the girl as % expressed of NCHS median weight would be = 8.5/10.8×100 = 78.7%.

We have learnt about two important component for growth assessment i.e. how to find out the correct age and how to select and use the growth standards. Also, earlier, we learnt about how to measure weight, height, MUAC and skinfold thickness, so now you are ready to learn how to determine the nutritional status of children based on these measurements. Let us first start with MUAC.

7.7.1 Determination of Nutritional Status using MUAC

How do we determine nutritional status using MUAC as a body measurement? Let us find out.

The arm circumference increases rapidly from birth to one year, from 11 cm to 16 cm. Between the first and fifth birthdays, it remains fairly constant at about 16 to 17 cm among well-nourished children. During this time, the fat of early infancy is replaced by muscle. A value of 16.5 cm is the reference cut-off point used as a standard. Table 7.3 gives classification for grades of malnutrition for MUAC.

Table 7.3: Classification for grades of malnutrition for MUAC

S.No.	MUAC (cm)	Category
1	> 13.5	Normal
2	12.5 - 13.5	Possible mildly malnourished
3	<12.5	Severely malnourished requires immediate attention

If the MUAC measurement is about 13.5 cm or more , the child is classified as normal and if it is less than 13.5, the child is malnourished. Therefore, using the techniques explained in sub-section 7.6.2, we can measure the MUAC and compare the results with the reference given in Table 7.3.

Let us now go over to how we determine nutritional status using weight and height.

7.7.2 Determination of Nutritional Status using Weight and Weight

Relatively speaking, weight, height and MUAC have come to be considered the most sensitive parameters for assessing nutritional status of children under the age of six years. Several methods have been suggested for the classification of nutritional status based on these measurements. The heights and weights can be exp essed in a number of ways in relation lo reference data. These include: (a) by the use of mean and standard deviation values, and (b) by calculating percentages of the median value of reference population which is assigned as 100 percent. You might recall learning about different methods of classification of malnourished children in Unit **3.** We will just recapitulate these here.

Various methods have been suggested to classify children into various nutritional grades using the body weights alone or in combination with standing height/recumbent length. In addition, a method of classification to assess nutritional status of adults is also suggested. These methods are highlighted in Table 7.4.

Table 7.4: Methods of classification to assess nutritional status of adults and children

S.No.	Method of classification	
	Children	Adults
A	Gomez Clasification	Body mass index
B	Indian Academy of Pediatrics (IAP) Classification	
C	Standard Deviation Classification	

Let us start with methods of classification suggested for children. We will **start** with Gomez classification.

A. Gomez Classification

Gomez classification is based on body weights only. In this, the weights of children measured are expressed as percent of the NCNS median value of reference population, which is assigned as 100 percent. Table 7.5 gives Gomez classification for weight for age.

Table 7.5: Gomez classification for weight for age

% Weight for age of NCHS	Type of undernutrition	Grade of undernutrition
≥ 90	Normal	Normal
75 - 89.9	Mild	I
60 - 74.9	Moderate	II
<60	Severe	III

This classification is not frequently used in India. Therefore, let us understand the IAP classification, which is extensively used for growth monitoring of children in one of the largest nutrition intervention progsammes i.e. ICDS in India.

B. Indian Academy of Paediatrics (IAP) Classification

The IAP classification is also based on weight only. Table 7.6 gives the IAP classification.

Table 7.6: IAP classification

Grade of undernutrition	% Weight for age of NCHS Standard
Normal	≥ 80
I	70-79.9
II	60-69.9
III	50-59.9
IV	< 50

This classification is currently used by the Integrated Child Development Scheme (ICDS) sponsored by the Government of India for selecting beneficiaries and growth monitoring. Figure 7.6 gives the growth chart used in the ICDS programme. It may be noted that the cut-off points used for grading children in this classification are arbitrary. That is, if a child's weight is 80% or more of standard, then he/she is classified as normal *weight.* If it is between 70-79.9%, then it is classified as grade 1 and so on, as indicated in Table 7.6. We can explain it with the help of the same example as used earlier under section 7.7. You may recall reading in Table 7.2 that median weight of the 18 month old child is 10.8 kg. Normal weight of this child according to IAP classification should be > or = to 80% or ≥ 8.64 kg (80/100×10.8=8.64 kg). But if an 18 month old child weighs only 8.5 kg, then she would be classified as Grade I (falling between 70-79.9% weight for age of NCHS value i.e. 7.56 - 8.63 kg). Like this the calculations can be done for other cases.

C. Standard Deviation Classification

The third classification i.e. *the standard deviation classification* is based on weight and height both,

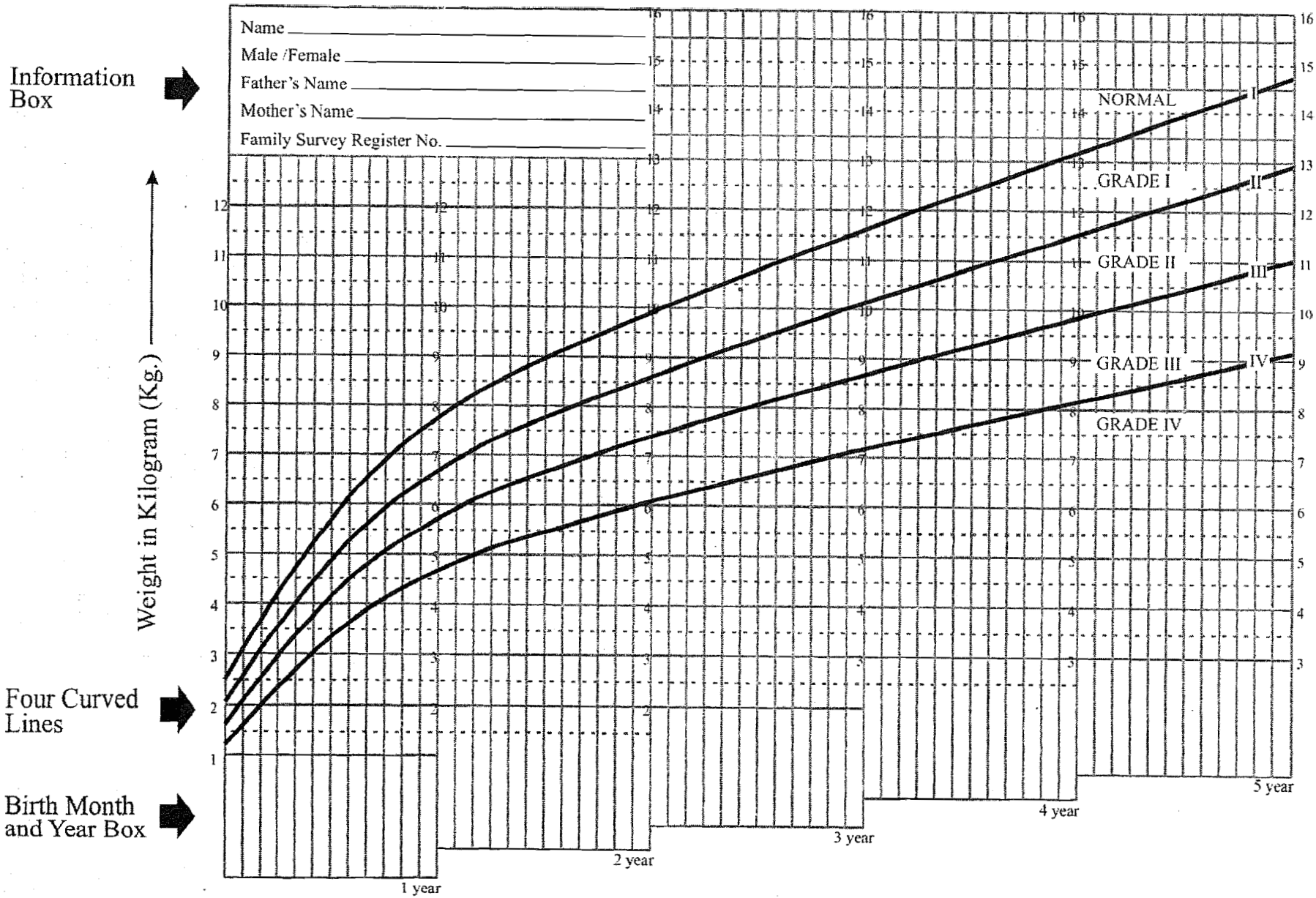

Figure. 7.6: Growth chart used in ICDS programme

Normal growth is considered to encompass values within two standard deviations of the mean (25D). Standard deviation is a measure of dispersion or variation in measurements. The World Health Organization recommends use of this classification to assess. the extent of malnutrition in children.

The standard deviation classification comprises of:

- Weight for age (underweight),
- Height for age (stunting), and
- Weight for height (wasting)

Let us understand these concepts in greater details.

- *Weight for age:* Weight for age is an indicator of undernutrition. The classification is given in Table 7.7.

Table 7.7: SD classification for weight for age

Grade of Undernutrition	SD of NCHS weight for age
Normal	≥ 2 SD
Undernutrition	< 2 SD
Severe Undernutrition	< 3 SD

One of the problems in measuring weight is that quite a large number of children with oedema (swelling of feet) may not be classified as acutely and severely malnourished. To overcome the problems of interpretation of the data on weight of children with oedema, the Wellcome classification classifies the oedematous children who measure 60-80% of the reference median weight for age are classified as having *kwaslziorkor,* while oedematous children below 60% are classified as having *marasmic kwashiorkor.* The term *marasmus* is applied to *children whose weight is less than 60% of the expected weight for age without oedema.* Those children who are 60-80% of the reference standard but without oedema are classified simply as *underweight children.*

- *Height for age (Stunting):* Height for age is a measure of stunting. It is well known that height for age is less only when children are exposed to malnutrition over a long period. The extent of height deficit in relation to age may be regarded as a measure of the duration of malnutrition. Therefore, stunting is considered as an index of *long duration of malnutrition.* Using height for age of NCHS standards children can be classified into different grades of stunting. The recommended classification is given in Table 7.8.

Table 7.8: SD Classification for height for age

Grade of Stunting	SD of NCHS height for age
Normal	≥ 2 SD
Stunting	< 2 SD
Severe stunting	< 3 SD

Using this table, we can grade the children as normal or stunted.

It is not uncommon to find considerable percentage of rural children appearing as apparently normal. When their ages are assessed it would be apparent that these children are stunted. These children are actually nutritional dwarfs and require intervention.

- *Weight for Height (wasting):* A measure of weight against height is an indicator of *wasting.* It is also common to observe a large number of children who are wasted and emaciated. Wasting is considered as an index of *short duration undernutrition. In* other words, even in middle and high-income group of children, an exposure to common childhood morbidities like diarrhoea, respiratory infections and measles can lead to weight loss and wasting. The commonly used weight-for-age classification does not take into account the changes in weight due to variations in height/length. Weight is related to height and it is therefore necessary to take into account the same particularly to assess wasting. Tables of weight for height (also believed to be age independent) are available based on the measurements of height and weight, of a large number of normal and healthy children. Weight for height less than 2SD of NCHS standards is considered to indicate wasting in preschool children. As in the case of height and weight, all the values less than 3 SD of NCHS standards' are considered to indicate severe wasting. Table 7.9 gives SD classification for weight for height.

Table 7.9: SD classification for weight for height

Grade of wasting	SD of NCHS weight for height
Normal	≥ 2 SD
Wasting	< 2 SD
Severe wasting	< 3 SD

Weight for height is also a good prognostic indicator of severe malnutrition, and has often been considered as a good index of current nutritional status.

Thus, we saw that there are methods to classify grades of malnutrition in children. Can we use the above indicators to assess the nutritional status of adolescents? Yes, weight for age and height for age are commonly used for this purpose. Very often body mass index is also used as an indicator to assess the nutritional status of adolescents. What is body mass index? Read the next section and find out. You will realize that we can also assess the nutritional status of adults using the BMI.

D. Body Mass Index (BMI)

The ratio of weight (in kg) / Height (m) ^{2} is referred to as *Body Muss Index (BMI).* After the cessation of linear growth around 21 years, weight for height indicates muscle fat mass in the adult body. It, therefore, provides a reasonable indication of the nutritional status of adults. The BMI has a good correlation with fatness (over weight or obesity). In the case of adults, the following classification suggested by *James and coworkers* as given in Table 7.10 is extensively used at present.

Table 7.10: BMI classification for adults

BMI class	Presumptive diagnosis
<18.5	Chronic energy deficiency
18.5-20.0	Low Normal weight
20.0-25.0	Normal
25.0-30.0	Obese grade 1
>30.0	Obese grade II

Table 7.10 shows BMI ranging from 20.0-25.0 is normal, BMI<18.5 indicates chronic undernutrition, while more than 25.0 is considered as an indicator of overweight/ obesity.

The discussion above focused on how to determine the nutritional status of individual children and adults. Now let us now learn how to determine nutritional status of community or community groups.

7.8 METHODS OF ASSESSMENT OF NUTRITIONAL STATUS OF COMMUNITY

We learnt about various methods to classify the grades of malnutrition for individual children. Now, how do we assess the grade of malnutrition for a community itself, where all these children reside? For this purpose, we use what is known as *Distance charts/Percentile Charts.*

At the community level, the means/medians (averages) of the weight and height measurements are compared with those values obtained on standards of corresponding ages. These can be plotted on growth chart plotted with the standards of reference. Such charts are known as *distance charts,* and indicate the growth pattern of the community in relation to normal children. It is common to use percentile charts for the purpose. Surveys carried out in different parts of the country indicate that, on the average, an average Indian child corresponds to the 5^{th} percentile of NCHS standards. In other words, an average Indian child has measurements of weight/height corresponding to the lowest 5% of American children. Thus, distance charts are the simplest tools to assess the nutritional status using anthropometry.

So we learnt about nutritional anthropometry as one of the methods to directly assess nutritional status of individuals and community in this unit. In the next unit, we will learn about other methods of direct assessment of nutritional status. Now, let us recapitulate what we have learnt so far.

Check Your Progress Exercise 3

1. List methods of classification for nutritional status suggested for children.

   .....

   .....

2. List the method for assessing nutritional status of adults

   .....

   .....

3. Activity

   The following are the weights obtained on a group] of children. Distribute them according to Indian Academy of Paediatrics. **Hint:** *Express the values as % of NCHS weight for* ***age provided*** *in Table-7.2.*

S.No	Age (months)	Sex	Weight (kg)	% of NCHS values for weight for age
1	12	Boy	6.2	
2	18	Girl	9.8	
3	27	Girl	8.1	
4	36	Boy	10.9	
5	**9**	Boy	**7.5**	
6	42	Boy	14.5	
7	15	Girl	7.2	

7.9 LET US SUM UP

This unit focused on two methods of assessment of nutritional status. These are indirect assessment and direct assessment methods. Indirect assessment of nutritional status can be done by using mortality, morbidity data and ecological data. Some of the data used for this purpose are age specific mortality rate, cause specific mortality rate, cause specific nutrition - relevant morbidity rates and feeding practices in children.

Direct assessment method involves using certain indicators like weight, height etc. on representative sample of community to measure nutritional status. Methods used to directly assess nutritional status are: Nutritional anthropometry, Clinical assessment, Biochemical assessment and Dietary assessment. This unit focused in detail on Nutritional anthropometry. Nutritional anthropometry is a measurement of human body at vasious ages and levels of nutritional status. The body measurement commonly used in nutritional anthropometry are weight, height, mid upper arm circumference and body fat. These measurements are then compared with a frame of reference to classify individuals under different grades of malnutrition.

7.110 GLOSSARY

Anthropometry the field that deals with the physical dimensions, proportions, and composition of the human body, as well as the study of related variables that affect them.

Prospective survey : a survey in which the disease or outcome has not occured at the time the investigation begins.

Stunting : shortness in length or height in the body.

Triceps : a muscle found in upper arm region.

Wasting : thinness or emaciation in the body.

7.11 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress Exercise 1

1. Three main purpose of nutritional assessment are:

   i) To identify facts about nutrition situation and guide action to improve nutrition and health

   ii) To sensitize politicians and administrators

   iii) To formulate public health strategy

2. Different methods of nutritional assessment are direct and indirect nutritional assessment.

3. Three health statistics data used for indirect nutritional assessment are age specific mortality rate, cause specific mortality rate and cause specific nutritional relevant morbidity rates.

4. Three ecological factors used for indirect nutritional assessment are:

   i) Breast feeding and complementary feeding

   ii) Food consumption data, and

   iii) Socio economic profile.

Check Your Progress Exercise 2

1. Various methods used to directly assess nutritional status are:

   i) nutritional anthropometry, ii) clinical assesstnent iii) biochemical assessment, and iv) dietary assessment

2. Uses of Anthropometry are listed as follows: Nutritional anthropometry is a very useful tool. It helps in:

   - assessment of extent of undernutrition (<2SD of NCHS reference values) of vulnerable groups of population.
   - monitoring of individual children at regular intervals (monthly or quarterly) to find out faltering in growth (deterioration/no change of growth) to help in early detection and initiating prompt remedial measures.
   - identification of children who are at risk of undernutrition, to target and prioritize nutrition action programmes so as to control the extent of undernutrition.
   - mid term appraisal or terminal evaluation to assess whether intervention programmes have achieved the objectives.

3. The most commonly used measurements in routine surveys are a) Mid-upper arm circumference; b) Body Fat; c) Body weight and d) Standing height or Crown-heel length.

Check Your Progress Exercise 3

1. Methods of classification for assessing nutritional status of children are: Gomez classification, Indian Academy of Pediatrics and Standard deviation.

2. Method for assessing nutritional status of adults is Body Mass Index (BMM)

3. Activity: The weights expressed as % of NCHS values for weight for age are.

S.No.	% of NCHS values for weight for age
1.	60.8
2.	90.7
3.	65.3
4.	74.6
5.	**81.5**
6.	**'92.3**
7.	70.6