

Food Nutrition & Dietetics (834)

(Class XI) (2018-19)

The discipline of nutrition empowers learners to develop an understanding of the concept, principles of nutrition which will enable them to make the best possible choices of food for meeting the nutritional needs of self, family and community at large. It is so designed to help learners understand the concept of food and nutrition security and create an awareness regarding major public health/nutrition problems affecting vulnerable sections of the society and strategies, programmes, policies enacted by the Government for combating these problems. Further the course will focus on study about the concept, scope, need, importance and process of nutrition education. Yet another focus of the discipline is to provide knowledge to learners for nutritional therapy and counseling service for the purpose of disease management. Creating awareness towards food safety and quality control measures, laws and policies is another important focus.

The syllabus will help learners develop knowledge and skills in this area. This would make them competent to meet challenges of becoming a responsible citizen and effective nutrition educator. The objectives of the course are to:

Objectives:

The syllabus of nutrition at Senior Secondary level develops an understanding in the learners that the knowledge and skills acquired through the study of nutrition facilitates development of good health and well being for self, family and community. It endeavors to –

- Acquaint learners with the basics of food, nutrition, health, fitness. and food safety and quality control,
- Sensitize learners to the common nutritional disorders effecting vulnerable groups in our country and strategies to manage them,
- Impart knowledge of nutrition and lifestyles to enable prevention and management of diseases.
- Develop skills of communication to assist in advocacy and dissemination of knowledge to community.
- Enable learners to become alert and aware consumers, and
- Inculcate healthy food habits.

CLASS XI (2018 – 19)

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(Marks 70)

Unit 1: Food and Nutrition: Basic Concepts

Marks 15

- Food, Nutrition, Health, Fitness, Primary Health Care and Nutritional Status (Definition, Inter relationship in maintaining good health and well being)
- Food (Functions and Constituents of food –Nutrient and Food Groups : Basic concepts
- Nutrients: Functions, Sources, Digestion, Absorption, Utilization and Requirements
- Recommended Dietary allowances and RDA for Indians (ICMR 2010) and their uses in planning diets.
- Concepts of meal planning, factors affecting meal planning, and Balanced diet (concept and guidelines in planning balanced diets)

Unit 2: Nutrition through the Life Cycle

Marks 20

- **Nutrition during Infancy (0-1years) and Preschool years (1-6 years):** Infancy, preschool period (critical from Growth, development view point, nutrient requirements- Infant and Young \Child Feeding practices, planning balanced diet for infants, preschoolers and special considerations for feeding young children.
- **Nutrition during Childhood and Adolescent:** Growth, Development, Nutrient needs, meeting nutrient needs through planning balanced diets, packed lunches factors influencing food and nutrient needs during adolescence (peer pressure,body image,media, stress,fasting)
- **Nutrition during Adulthood and Old Age:** Factors influencing nutrient requirements(age, gender,activity level-sedentary, moderate, heavy) Nutrient needs(RDA) and meeting requirement by planning balanced diets.
- **Nutrition during pregnancy and lactation:** Understanding why pregnancy and lactation are critical from nutritional point of view, recommended dietary allowances and planning balanced

diets.Special considerations in pregnancy-nausea,vomiting,heart burn,constipation)

Unit 3: Public Health and Nutrition: Basic Concept

Marks 10

- Human Development Index (HDI), Sustainable Developmental Goals (SDG) : Basic Concepts
- Malnutrition (Undernutrition/Overnutrition): Concept/definition, causes (conceptual framework by UNICEF), consequences
- Methods for assessment of nutritional status (Direct methods – Anthropometry, Biochemical, Clinical, Dietary survey: Basic concept)

Unit 4: Public Health and Nutrition Disorders

Marks 15

- Major Deficiency Disorders: (PEM in the context of underweight, stunting,wasting, SAM; Nutritional Anaemia with special reference to Iron Deficiency Anaemia; Vitamin A Deficiency (Xerophthalmia); Iodine Deficiency Disorders; Zinc deficiency: Prevalence, Causes, Consequences and its control.
- Other Nutritional Problems: Vitamin B complex deficiencies, vitamin C deficiency, Vitamin D deficiencies.
- Overweight/Obesity: Definition/Classification (WHO), Causes and Consequences.
- Non Communicable Diseases (Diabetes, CVD, cancer): Concept, Prevalence, Causes (Behavioural) and Consequences

Unit 5: Public Health and Nutrition: Programmes and Policies

Marks 5

- National programme for welfare of women & Children :objectives, beneficiaries,functions/components) (ICDS, Midday meals)
- Programmes for welfare of Adolescent girls and Women (Rashtriya Kishore Swasthya Karyakram (RKSK),Rajiv Gandhi Scheme for Empowerment of Adolescent Girls (SABLA), Indira Gandhi Maitritva Sahyog Yogna (IGMSY)

Unit 6: Nutrition Education, Communication and Behaviour Change

Marks 5

- Information, Education and Communication (IEC) for Behaviour Change: Definition, Nutrition Education: Need, Scope and Importance
- Process of nutrition education communication

- Nutrition Communication: Media and Multi-Media combinations: Types (Interpersonal communication: Individual and group approach; Mass Media, Traditional Media)

CLASS XI (2018 –19)
PRACTICAL

(Marks 30)

1. Identify and selection of rich sources of nutrients (Protein, Iron, Calcium, Vitamin A, Fat, Vitamin C)
2. Study of physical self with reference to assessment of nutritional status:
 - a) Age, height, weight, MUAC and compare with Standard/References
 - b) Observation of clinical signs / symptoms specific to good health Wellbeing
 - c) Record own diet for a day using 24 hour recall
 - d) Evaluate qualitatively for adequacy using Food groups and how to improve the same
 - e) Record Food practices including food taboos, fasting and special food preparation for adolescent, pregnant/lactating women.
 - f) Plan and design supplementary/complementary foods for infants and supplementary foods for preschoolers, highlighting their nutrient contribution.
 - g) Preparation of different healthy snacks for an adolescent suitable in her/his context
 - h) Study self with reference to physical activity (24 hours).
3. Collect five nutrition/health/hygiene messages from print and electronic media which have influenced one self.
4. Plan and prepare any one print/traditional/electronic media/approach you would use to disseminate nutrition/health/hygiene message to the community members.

5. Visit to any one programme/ institution (Govt. /NGO) for children/maternal nutrition and health well being (ICDS, MDM primary health care.); observation of activities in the programme and report writing.

UNIT 1: RECOMMENDED DIETARY ALLOWANCES AND RDA OF INDIANS (ICMR 2010) AND THEIR USES IN PLANNING DIETS

Learning Objectives:

After reading this unit, the students will be able to:

- define the terminologies and concepts used in relation to human nutritional requirements,
- discuss the concept of recommended dietary allowance,
- state the significance and uses of recommended dietary allowances, and
- present the current nutrient recommendations for Indian population.

In a family there may be infants, young children, adolescent, adults, and elderly all living under one roof. It is always a big challenge to provide a good nutritious diet for each of the member, particularly when their needs, preferences vary. So what should be the guiding factor to ensure balanced meals that meet the needs of all members? Is there a Standard or a Reference that would serve as a goal for Good Nutrition? This section focuses on this important concept of Recommended Dietary Allowances.

RECOMMENDED DIETARY ALLOWANCES: BASIC CONCEPT

Humans need a wide range of nutrients to lead a healthy and active life. The amount of each nutrient needed for an individual depends on age, body weight, physical activity, physiological state (pregnancy, lactation) etc. So basically the requirement for nutrients varies from individual to individual. So, what do we mean by the term "*Nutrient Requirement*" here?

The requirement for a particular nutrient is the minimum amount that needs to be consumed to prevent symptoms of deficiency and to maintain satisfactory level of the nutrient in the body.

For example in case of infants and children, the requirement may be equated with the amount that will maintain a satisfactory rate of growth and development. Similarly for an adult the nutrient requirement is the amount that will maintain body weight and prevent the depletion of the nutrient from the body which otherwise may lead to deficiency. In physiological condition like pregnancy and lactation, adult women may need additional nutrients to meet the demand of fetal growth along with their own nutrient needs.

Now within each group (say infants or an adults etc) there may be individual variations in the nutrient requirements. For instance, there may be a period of low intake or the quality of the diet may

Bioavailability refers to the release of nutrient from the food, its absorption in the intestine and bio-response

vary, similarly the effect of cooking and processing may be different and bioavailability of the nutrient from the diet may also vary.

So how do we account for this? Well a *safety factor* is added over and above the nutrient requirement for each group to arrive at the Recommended Dietary Allowances.

$$\text{REQUIREMENT} + \text{SAFETY MARGIN} = \text{RECOMMENDED DIETARY INTAKE}$$

The Recommended Dietary Allowances (RDA) are the levels of intake of the essential nutrients that are judged to be adequate or sufficient to meet the nutrient requirement of nearly all (97 to 98 percent) healthy individuals in a particular life stage and gender group

From our discussion above it must be clear to you that the Nutrient Requirement of an individual and the Dietary Allowance for a group or a population are distinctly different. RDA takes into account the variability that exists in the requirement of a given nutrient between individuals in a given population group. So RDA is neither minimal requirement nor necessarily optimal level of intake. Rather, RDA is the *safe and adequate level*, which incorporates margin of safety intended to be sufficiently generous (high enough) to encompass the presumed variability in requirements among individuals and meet the needs of almost all healthy people.

Further please note, RDA's do not apply to people who are suffering from disease which influence the nutrient intake. They only apply to healthy people.

Next we shall review the significance, uses of RDA's.

SIGNIFICANCE/USES OF RDA

RDA, we know, represents the level of the nutrient to be consumed daily to meet all the requirements of most of the individuals in a given population. So RDA's help us plan balanced diets which include a variety of foods derived from diverse food groups which help meet the nutrient requirements. Other than this basic use, RDA's have come to serve many important purposes. The various applications of RDA include:

- Comparison of individual intakes to the RDA allows an estimate to be made about the probable risk of deficiency among individuals,
- Modifying nutrient requirements in clinical management of diseases,
- To help public health nutritionists to compose diets for schools, hospitals, prisons etc.
- For health care policy makers and public health nutritionists to design, develop nutrition intervention programmes and policies,
- For planning and procuring food supplies for population groups,
- For evaluating the adequacy of food supplies in meeting national nutritional needs,

- For interpreting food consumption records of individuals and populations,
- For establishing Standards for the national feeding programmes implemented by the Governments for its vulnerable population,
- For designing nutrition education programmes for the masses,
- For developing new food products and dietary supplements by the industry,
- Establishing guidelines for the national labeling of packaged foods (by Food Standards Safety Authority of India (FSSAI))

So that was a comprehensive list of uses of RDA. Next let us learn about the Recommended Dietary Allowances for Indians.

Recommended Dietary Allowances (RDA) for Indian Population

For the Indian population, the dietary standards have been computed by the Indian Council of Medical Research (ICMR). These recommendations have been published as "Nutrient Requirements and Recommended Dietary Allowances for Indians" (ICMR 2010)

The recommendations are constantly revised whenever new data is available. The last recommendations were revised in 2010, based on the new guidelines of the International Joint FAO/WHO/UNU Consultative Group and based on the data on Indians that had accumulated after 1989 recommendations. Table 1(a) and Table 1(b) present these recommendations. Study them carefully. To help you understand these recommendation here are a few highlights:

1. Note, the RDA for Indians are presented for the different age categories: 0-6 months, 7 to 12 months, 1 – 3 years, 4 – 6 years, 7 – 9 years, 10 – 12 years, 13 – 15 years, 16 – 18 years, adult man and women..
2. Recommendations are given for energy and all other nutrients including proteins, visible fat, calcium, iron, retinol, Beta Carotene, thiamine, riboflavin etc.
3. Recommended dietary allowances for adults are based on sex (male, female), body weight and physical activity level (i.e. Sedentary, Moderate and Heavy work) .
4. RDA for energy is expressed in kilocalories (Kcal), for proteins, fats in grams (g), and for calcium, iron, vitamins and minerals in milligram (mg) or microgram.
5. RDA for protein is based on body weight. The relationship can be expressed as 1g protein per kg body weight in the case of adults. It varies for other age categories.
6. RDA for energy and protein are given as additional intakes in pregnancy and lactation, indicated by a (" + " sign). This requirement is over and above the normal requirement of adult women. RDA for other nutrients are given as total intake figures.
7. In infancy RDA's for energy, protein, iron, thiamin, riboflavin and niacin are expressed as per kg body weight (expected for a healthy, normal growing infant of a particular age)
8. RDA for Vitamin A have been given in terms of retinol or alternatively in terms of Beta Carotene.

Summary of Recommended Dietary Allowances (RDA) for Energy, Protein, Fat and Minerals for Indians – 2010

Group	Category/Age	Body Weight (Kg)	Net Energy (Kcal/d)	Protein (g/d)	Visible Fat (g/d)	Calcium (mg/d)	Iron (mg/d)	Zinc (mg/d)	Magnesium (mg/d)
Men	Sedentary work	60	2320	60.0	25	600	17	12	340
	Moderate work		2730		30				
	Heavy work		3490		40				
Women	Sedentary work	55	1900	55	20	600	21	10	310
	Moderate work		2230		25				
	Heavy work		2850		30				
	Pregnant		+ 350		30				
	Lactating 0-6 m		+ 600		30				
Infants	6-12 m	5.4	+520	68	30	1200	21	12	30
	0-6 months		92 kcal/kg/d		1.16 g/kg/d				
	6-12 months		80 kcal/kg/d		1.69 g/kg/d		46 ug/kg/d	-	
Children	1-3 years	12.9	1060	16.7	17	600	09	5	50
	4-6 years	18.0	1350	20.1	25				
	7-9 years	25.1	1690	29.5	30				
Boys	10-12 years	34.3	2190	39.9	35	800	21	9	120
Girls	10-12 years	35.0	2010	40.4	35	800	27	9	160
Boys	13-15 years	47.6	2750	54.3	45	800	32	11	165
Girls	13-15 years	46.6	2330	51.9	40	800	27	11	210
Boys	16-17 years	55.4	3020	61.5	50	800	28	12	195
Girls	16-17 years	52.1	2440	55.5	35	800	26	12	235

Table 1(b) : Recommended Dietary Allowances for Indians (Vitamins)

Group	Category/Age	Body Weight (kg)	Vitamin A (µg/d)		Thiamine (mg/d)	Riboflavin (mg/d)	Niacin equivalent (mg/d)	Vitamin B ₆ (mg/d)	Ascorbic Acid (mg/d)	Dietary Folate (µg/d)	Vitamin B ₁₂ (µg/d)
			Retinal	Beta-carotene							
Men	Sedentary work	60	600	4800	1.2	1.4	16	2.0	40	200	1.0
	Moderate work				1.4	1.6	18				
	Heavy work				1.7	2.1	21				
Women	Sedentary work	55	600	4800	1.0	1.1	12	2.0	40	200	1.0
	Moderate work				1.1	1.3	14				
	Heavy work				1.4	1.7	16				
	Pregnant		800	6400	+0.2	+0.3	+2	2.5	60	500	1.2
	Lactating 0-6 months		950	7600	+0.3	+0.4	+4	2.5	80	300	1.5
	6-12 months				+0.2	+0.3	+3	2.5			
Infants	0-6 months	5.4	350	----	0.2	0.3	710 µg/kg	0.1	25	25	0.2
	6-12 months	8.4		2800	0.3	0.4	650 µg/kg	0.4			
Children	1-3 years	12.9	400	3200	0.5	0.6	8	0.9	40	80	0.2-1.0
	4-6 years	18.0			0.7	0.8	11	0.9		100	
	7-9 years	25.1	600	4800	0.8	1.0	13	1.6		120	
Boys	10-12 years	34.3	600	4800	1.1	1.3	15	1.6	40	140	0.2-1.0
Girls	10-12 years	35.0			1.0	1.2	13	1.6			
Boys	13-15 years	47.6			1.4	1.6	16	2.0	40	150	0.2-1.0
Girls	13-15 years	46.6			1.2	1.4	14	2.0			
Boys	16-17 years	55.4			1.5	1.8	17	2.0	40	200	0.2-1.0
Girls	16-17 years	52.1			1.0	1.2	14	2.0			

Source: Nutrient Requirements and Recommended Dietary Allowances for Indians (ICMR 2010)

Now that we have a fair good idea about recommended dietary allowances surely you should be able to recommend what individuals should eat and in what amounts to ensure a balanced diet. Off course knowledge of nutrients and the rich food sources of these nutrients will form the basis for diet planning. The amount of different foods to be consumed would depend on the RDA. Higher the RDA for a particular nutrient, the more should be the consumption of food rich in that nutrient. For example, we learnt that the RDA for energy for a heavy worker (adult male) is more as compared to a sedentary male adult. To meet these increased high needs of energy we must ensure that we include more of carbohydrates and fat rich foods in the diet of the heavy adult worker. Carbohydrate rich foods such as cereals, sugars, roots and tubers and fat from oils, butter, ghee etc. will help meet the increased energy requirement.

Similarly in case of infants (6-12 months of age) when the protein needs are high (1.69 g/kg body weight/d) as compared to adults (1g/kg body wt) it would be recommended that high protein rich foods such as milk and milk products, pulses, meat and meat products may be included in the diet of the infants. A detailed review on planning balanced diet is covered in another unit.

KNOWLEDGE ASSESSMENT - 1

Fill in the blanks

1. The RDA for energy is expressed as ----- .
2. During periods of physiological stress such as during pregnancy and lactation the requirement for energy and protein is given as ----- intake.
3. In infancy RDA for energy, protein etc is expressed as per kg ----- .
4. RDA for adults are based on sex, body weight and ----- .
5. Nutrient requirement is the ----- amount that needs to be consumed to prevent symptoms of deficiency and maintain satisfactory level of the nutrient in the body.
- 6.----- is added to the nutrient requirement to cover for variations in requirement from individual to individual
7. RDA's are basically ----- plus safety margin.
8. .RDA is the average daily nutrient intake sufficient to meet the nutrient requirement of nearly ----- percent of healthy individuals in a particular life stage and gender group.
9. In India the RDA's are provided by ----- .
10. RDA's apply only to ----- people and not to people suffering from ----- .

Answer: 1) Kilo Calories (Kcal); 2) additional; 3) body weight; 4) physical activity; 5) minimum; 6) Safety margin; 7) Nutrient requirement, 8) 97-98; 9) ICMR; 10) healthy, disease.

UNIT: 3 - PUBLIC HEALTH AND NUTRITION: BASIC CONCEPT

Unit Code:	UNIT TITLE: PUBLIC HEALTH AND NUTRITION : BASIC CONCEPT			
	Duration:			
Location:	SESSION 1:PUBLIC HEALTH AND NUTRITION , MALNUTRITION : BASIC CONCEPTS			
Classroom or internet	Learning Outcome	Knowledge Evaluation	Performance Evaluation	Teaching and Training Method
	1. What is Public Health Nutrition	1. Explain the concept of public health nutrition 2. Enlist the activities related to public health nutrition	1. Analyse the concept of public health nutrition 2. State the various activities which a public health nutritionist may perform	Interactive Lecture: Introduction
	2. Malnutrition: Basic concept, Causes and Consequences	1. Define Malnutrition and its components 2. Discuss the various causes of Malnutrition 3.Highlight the consequences of malnutrition	1. Explain the meaning of malnutrition, undernutrition and overnutrition 2. Explain the immediate, underlying and basic causes of malnutrition 3. State the consequences of malnutrition	Interactive Lecture: Introduction .
	SESSION 2: METHOD OF ASSESSMENT OF NUTRITIONAL STATUS			
	1. Nutritional Status Assessment Methods	1. Define Nutritional status. 2. Enlist the methods of assessment of nutritional status	1. Explain the concept of ABCD, in the context of nutritional status assessment	Interactive Lecture: Acquaint methods nutritional status assessment
	2. Anthropometric measurements	1. Explain the meaning of anthropometry 2. Discuss the measures used in anthropometry 3. Explain the different anthropometric indices	1. Explain the importance of weight, height and other measures and indices in the context of anthropometric	Interactive Lecture: Discussion of the importance and Standards



		used for infants, young children, older children, adolescents and adults.	measurements 2. Categorize individuals into different grades of malnutrition 3. Calculate Body mass index and categorize individuals into different grades of malnutrition using BMI.	anthropometry Activity: Encourage children to take weight, height of their peer and compare with Standard values Calculate BMI and compare with Standards.
	3. Clinical, Biochemical and Dietary Assessment Methods	1. Explain the clinical assessment method and the various sign and symptoms used in clinical assessment 2. Explain the concept of biochemical assessment giving examples. 3. Discuss the use of Dietary assessment method 4. Explain the most common method of diet survey i.e. 24-hour-recall.	1. Identify various clinical sign and symptoms specific to nutrient deficiencies 2. Link sign, symptom of deficiencies to various body parts, organs. 3. Discuss the uses and limitations of biochemical assessment method Describe the use of dietary assessment method in the context of 24-hour recall method.	Interactive Lecture: Acquaint the students with the clinical sign and symptoms specific to deficiency condition Activity: Involve children in collecting pictures from internet, newspaper etc..of clinical sign, symptoms of deficiency diseases. Activity: Carry a 24-hour recall of the food eaten by the students in the last 24 hours.
1Location: Classroom or internet	SESSION 3: HUMAN DEVELOPMENT INDEX (HDI) AND SUSTAINABLE DEVELOPMENT GOALS (SDGs)			
	1.Human Development Index (HDI) 2.Sustainable Development Goals (SDGs)	1.Explain the concept of Human Development Index 2.Discuss the concept, significance of Sustainable development Goals. 3.Identify the three most important goals and their targets of SDGs in the context of public nutrition	1. Explain the components and indicators of HDI 2. Present the HDI score of India 3. List the three important goals in SDG (public health point of view) 4 Highlight the targets to be achieved and what is India's performance so far?	Interactive Lecture: Acquaint the students to the concept of HDI and SDGs.

UNIT: PUBLIC HEALTH AND NUTRITION: BASIC CONCEPTS

Learning Objectives:

After reading this unit, the students will be able to:

1. explain the concept of public health nutrition
2. define and discuss the various form of malnutrition
3. enlist the direct methods of nutritional status assessment
4. discuss the use and interpretation of anthropometric measurements
5. explain the clinical, biochemical and dietary assessment methods of nutritional status assessment
6. discuss human development index and its various components, and
7. state the sustainable development goals and their targets.

SESSION 1: PUBLIC HEALTH NUTRITION AND MALNUTRITION: BASIC CONCEPTS

We begin our study with a brief understanding of public health nutrition. What is public health nutrition and as a public health nutritionist what activities one would be involved with? Let's find out.

Public Health Nutrition: Basic Concept

Nutrition, as you may be aware, is one of the major determinants of the health and well-being of individuals in a society. So an area of study which emphasizes the application of food and nutrition knowledge, policy and research to the improvement of health of populations is called public health nutrition. It is primarily concerned with improving nutrition in population groups. Study of public health nutrition may, therefore, include an understanding of:

- ☐ the most critical social, behavioural and food and nutrition factors that affect health,
- ☐ nature, causes and consequences of nutrition problems, malnutrition in a society,
- ☐ nutritional requirements and dietary guidelines for populations,
- ☐ design, planning, implementation and evaluation of nutritional programmes and how they can improve the nutritional status of the population,

- ☐ how nutrition related and food related public policies affect health especially in vulnerable groups,
- ☐ Nutrition education for behaviour changes etc.

The activities mentioned above are by no means a complete list of activities undertaken within the public health nutrition domain. But surely they give you an idea about this area of study.

It may be emphasized that public health nutrition is a vast field and has many aspects to it. At this stage we are not required to dwell on these various activities.

Nutritional problems, malnutrition - their causes, consequences, you have learnt from a major part of study of public health nutrition. So let us begin our study of this unit with a review on the concept, definition, causes and consequences of malnutrition.

Malnutrition: Basic Concept, Causes and Consequences

When you think of malnutrition what picture comes to your mind? Yes very often we picture malnutrition as undernutrition. We tend to picture a thin starved individual as malnourished. Malnutrition, in fact is "poor nutrition". But what we fail to understand is that malnutrition is an impairment of health resulting not only from a deficiency or lack of food/nutrients but also when there is excess or imbalance of nutrients in the diet.

So when we talk of malnutrition we refer to both:

- ☐ Under nutrition: not getting enough nutrients, and
- ☐ Overnutrition: getting more nutrients than the body needs.

Figure 1 illustrates the concept:

Nutrients are essential substances present in food necessary of bodily functions including proteins, carbohydrates, fats, vitamins and minerals

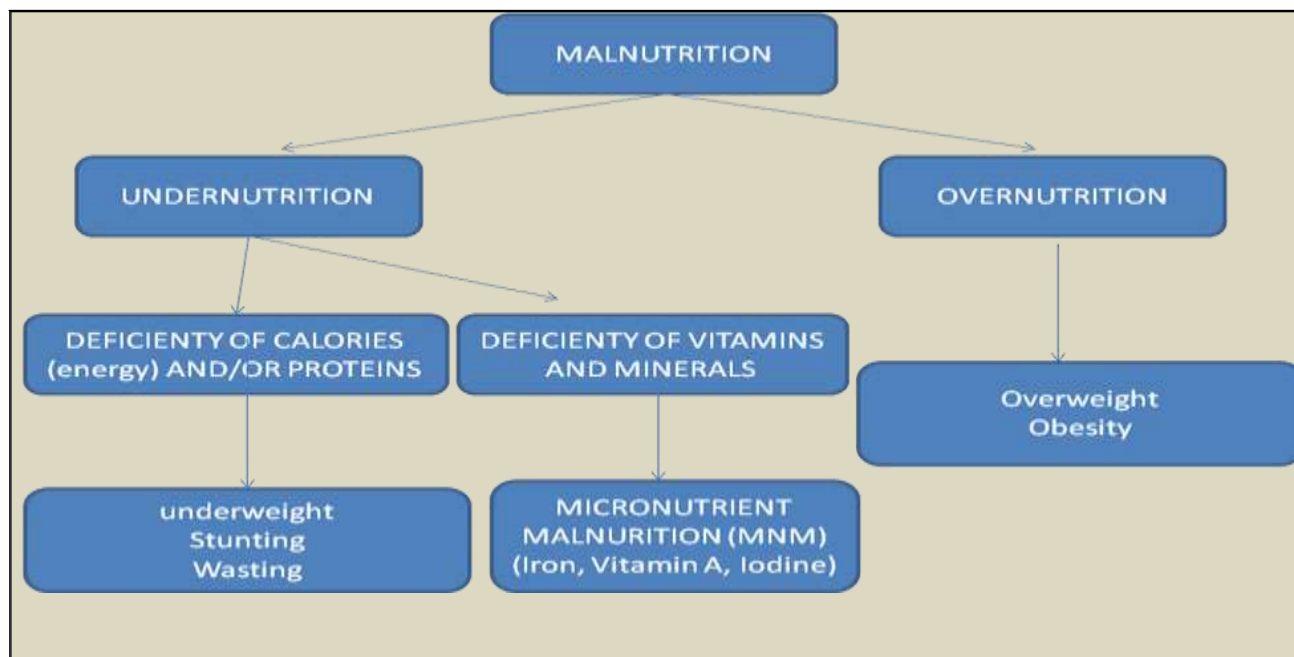


Figure 1: Malnutrition

Under nutrition is a condition which occurs when there is lack of adequate energy, protein and/or micronutrients (like iron, vitamin A etc.) in the diet. The basic requirement of nutrients for growth, development, body maintenance is not met leading to poor growth or protein energy malnutrition or deficiency diseases like anemia, permanent blindness etc. Overnutrition, on the other hand, is a form of malnutrition that occurs when we take more (or excess) of a nutrient than the body needs every day. Consumption of excess energy is an example of over nutrition leading to overweight or obesity. Overweight and obesity are defined as "abnormal or excessive fat accumulation that present a risk to health".

What are the factors contributing to malnutrition? Let us review.

Causes of Malnutrition

There can be many underlying causes of malnutrition. A conceptual framework on the causes of malnutrition was developed in 1990 by UNICEF. The framework shows that causes of malnutrition are multi-sectoral and classified as - Basic, underlying and Immediate as highlighted in Figure 2.

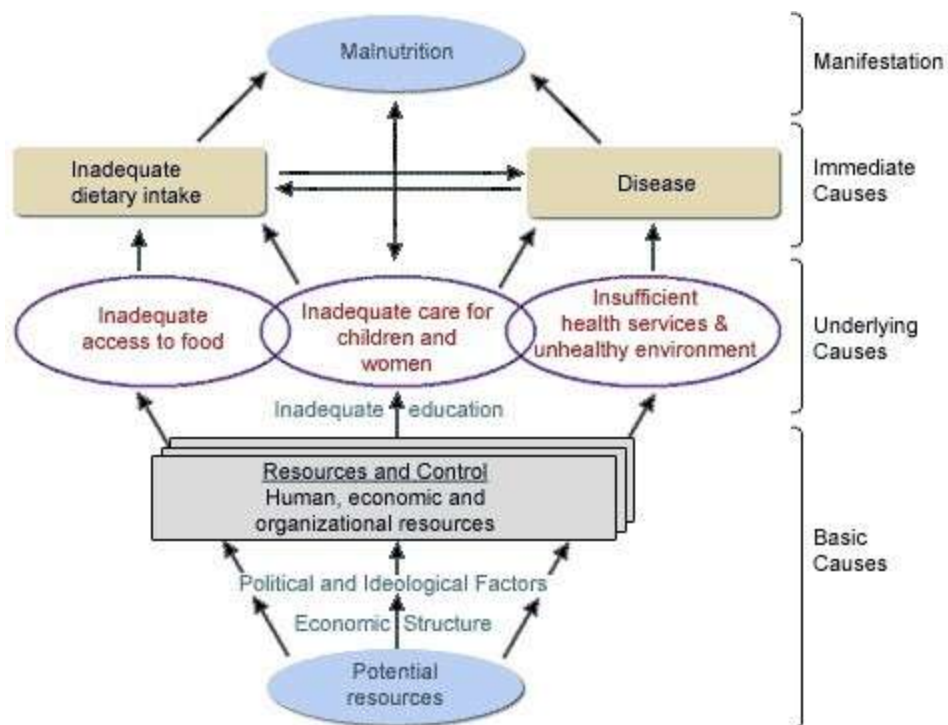


Figure 2: Causes of Malnutrition - UNICEF Framework

Immediate causes of malnutrition are at individual level including inadequate dietary intake and frequent illness and diseases. An individual's dietary intake and exposure to disease are affected by underlying factors at household/family level such as lack of availability of, access to and/or utilization of diverse diet, inadequate care and feeding practices for children combined with unhealthy household and surrounding environment and inaccessible and inadequate health care. Basic causes including the social, economical and political factors that neglect human rights, perpetuates poverty, denying the access of vulnerable populations to essential resources. These function at the Society level.

The causes of undernutrition and overnutrition are in many ways similar and interlinked. Factors such as poverty, lack of knowledge and access to adequate diet, poor infant and young child feeding practices, inadequate health care etc can lead to undernutrition as well as overweight and obesity.

Next let us get to know the consequences of malnutrition

Consequences of Malnutrition

The consequences linked with malnutrition can be devastating. Before we study the consequences let us get to know who are more likely to be suffering from malnutrition. Malnutrition affects first and foremost children under age of two, but young children under five years of age, adolescent, pregnant, lactating mothers, the elderly and the chronically ill are also vulnerable.

Malnutrition increases the risk of mortality (death) and morbidity (illness). In the long term chronic malnutrition during pregnancy and early childhood manifest as stunted growth (low height for age) and wasting (low weight for height). Children who are malnourished in the early years of life fail to grow and develop to their full potential, both physically and mentally. The consequences of stunting extend to adulthood increasing the risk of poor pregnancy outcome (i.e. the newborn is of low birth weight), impaired cognition that results in poor school performance, reduced economic productivity and earning. Stunted growth in early years increases the risk of overweight later in life and subsequently non communicable diseases such as cardiovascular diseases, diabetes, and hypertension.

Diets that are inadequate in terms of micronutrients (iron, iodine, Vitamin A) can lead to serious illness, including anaemia (iron deficiency), mental retardation and permanent blindness. People who suffer from malnutrition have fewer defenses against diseases i.e. have low immunity. They fall ill faster and easily and are less able to recover quickly and completely from the disease. Malnutrition increases the risk of infection and with infection there is reduced appetite, malabsorption which in turn increases the body's need for nutrients and leading to malnutrition creating a vicious cycle of malnutrition and infection.

Summary of the consequences of malnutrition are illustrated in Figure 3.

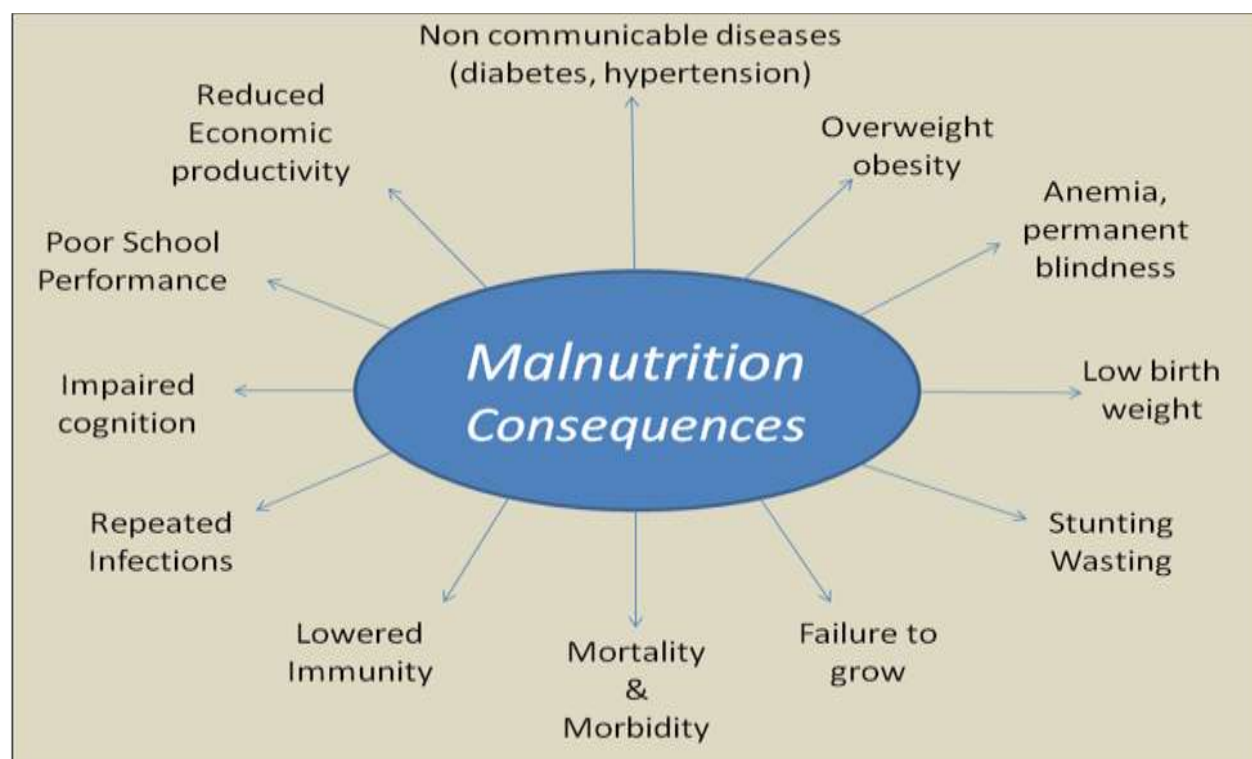


Figure 3: Consequences of malnutrition

Having considered the consequences of malnutrition it is important for us now as public health/nutrition students to be able to assess/identify individuals who are suffering from malnutrition or identify population groups or individuals who are at risk of malnutrition. How do we identify which individual is of optimal health, who is underweight or overweight or obese or suffering from a nutrient deficiency? How do we get to know the severity and magnitude of the nutritional problem? Are there any indicators? How do we assess the nutritional status? Our next section deals with this. But before we start the new section, here are few checks your progress exercises. Attempt the Knowledge Assessment -1.

KNOWLEDGE ASSESSMENT - 1

Fill in the blanks

1. Malnutrition refers to both ----- and----- .
2. The study which emphasizes the application of food and nutrition knowledge to the improvement of health and well being of individuals is called----- -- .
3. Abnormal or excessive fat accumulation that present a risk to health is called----- -- .
4. Diet inadequate in terms of the nutrient iron can lead to the deficiency condition called----- -- .
5. ----- and ----- are the immediate causes of malnutrition.

Answer: 1).undernutrition, obesity; 2) Public health nutrition; 3) obesity/overweight; 4) anaemia;
5) inadequate diet, diseases.

Multiple Choice Questions. (Read the statement and put a tick mark on the right answer).

1. Overweight is a consequence of:
 - a) deficiency of one or more nutrient
 - b) infections
 - c) excessive intake of energy
 - d) Both b and c
2. Underlying causes of malnutrition include:
 - a) Political factors
 - b) Illness and Disease
 - c) Inadequate care for women and children
 - d) Economic factors
3. Consequences of malnutrition include:
 - a) Lowered immunity
 - b) Poor productivity
 - c) Poor growth
 - d) All of the above
4. Non communicable diseases are consequences of:
 - a) Infections
 - b) Lowered immunity
 - c) Poor cognition
 - d) Overnutrition
5. Diabetes, Hypertension are an example of:
 - a) Infectious disease
 - b) Non communicable disease
 - c) Deficiency disease
 - d) None of the above

Answer: 1) - c; 2) - c; 3) - d; 4) - d; 5) - b.

SESSION 2: METHODS FOR ASSESSMENT OF NUTRITIONAL STATUS

Nutritional status of individuals is influenced by the diet (food intake) and the utilization of the nutrients but also by some internal external environmental factors. By studying these factors we can determine the nutritional status. Certain methods are used to assess nutritional status. We tend to classify them as direct methods and indirect methods. Here we will only focus on the Direct Methods of nutritional status assessment.

Nutritional status refers to the state of health of an individual as it is affected by the intake and utilization of nutrients (proteins, carbohydrates, fats, vitamins and minerals).

Direct methods used for assessment of nutritional status may be summarized as **ABCD**:

Anthropometric Measurements

Biochemical assessment

Clinical Methods, and

Dietary assessment

A. Anthropometric Measurements

The term Anthropometry literally means: Anthro = Man and Pometry = Measure

Anthropometry is the measurement of human body at various ages and level of nutritional status.

The most commonly used measurements include:

- Measurement of body weight,
- Measurement of standing height or crown heel length,
- Measurement of body circumferences, and
- Body fat (Skinfold measurement)

In children the three most commonly used anthropometric indices to assess their growth status are weight for age, Height/length for Age and Weight for Height. Let us briefly review each of these anthropometric indices.

i) Weight for Age

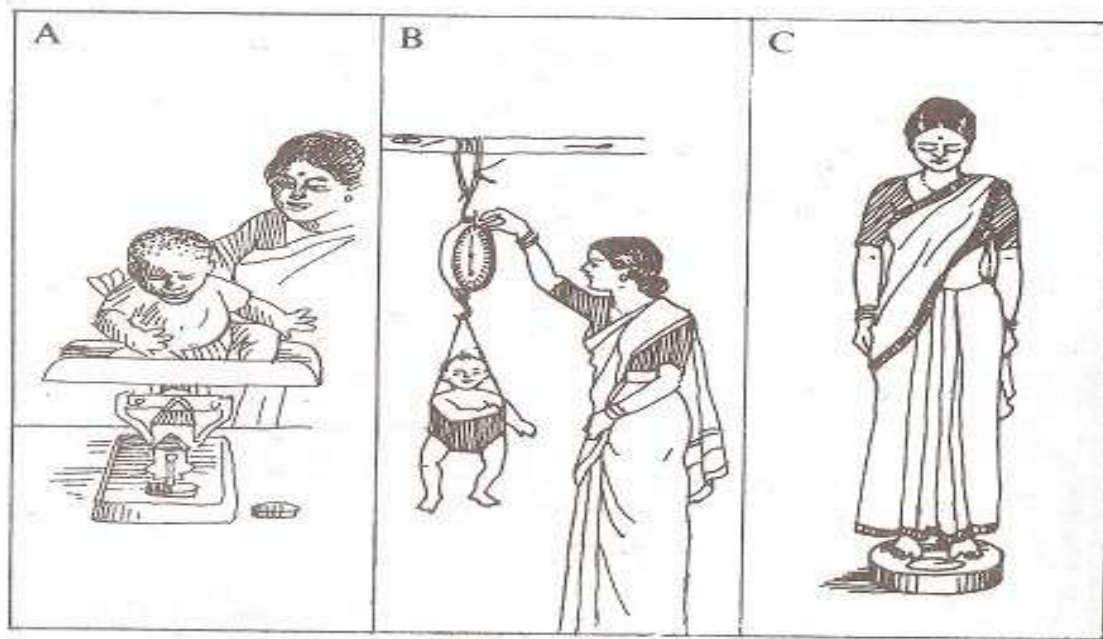
Body weight indicates body mass and is a composite of all body constituent such as water, mineral, fat, protein and bone. Repeated measurement of weight at regular period is a sensitive indicator of change in nutritional status. So any small changes or rapid changes in body weight of individuals, particularly children detected over a short period of time which may be due to poor diet and/or short duration illness and/or infection (such as diarrhoea) etc., indicates potential malnutrition. Weight is, therefore, indicative of short term malnutrition.

Along with weight, appropriate age assessment is also necessary for assessment of nutritional status. Why? Because we all know that body measures such as weight, height etc. increases with age. So if the correct age is not known it might not be possible to have an accurate assessment.

So Weight-for- Age is used as a measure of nutritional status. A low weight for age is referred to as underweight.

LOW WEIGHT FOR AGE is indicative of UNDERWEIGHT and of Short term malnutrition

Various types of weighing instruments are available to measure weight as highlighted in Figure 4.



a) Balance Beam

b) Spring Scale

c) Electronic scale

Figure 4: Weighing Scale

The next question then you may ask is how do we know that the actual weight measurement obtained for an individual is normal or appropriate for his/her age? For this we need to compare the actual obtained weight with a set of values called STANDARDS. In India for children we use the WHO GROWTH Standards (2006) to compare the data. These Standards are primarily average body measurements of well nourished and healthy children (belonging to well-to-do-society) who are medically and socially well protected and these values are used for purpose of comparison. Tables providing the WHO Standard measurements are given in Annexure 1 at the end of this unit for your reference.

Alternatively weight obtained can be plotted against age on a graph/chart so that growth pattern can be followed graphically in comparison to reference standards. This process is called Growth Monitoring. The charts used are Growth Charts which are designed as a means of monitoring and interpreting changes in weight over time. Refer to Figure 5 which illustrates the Growth chart

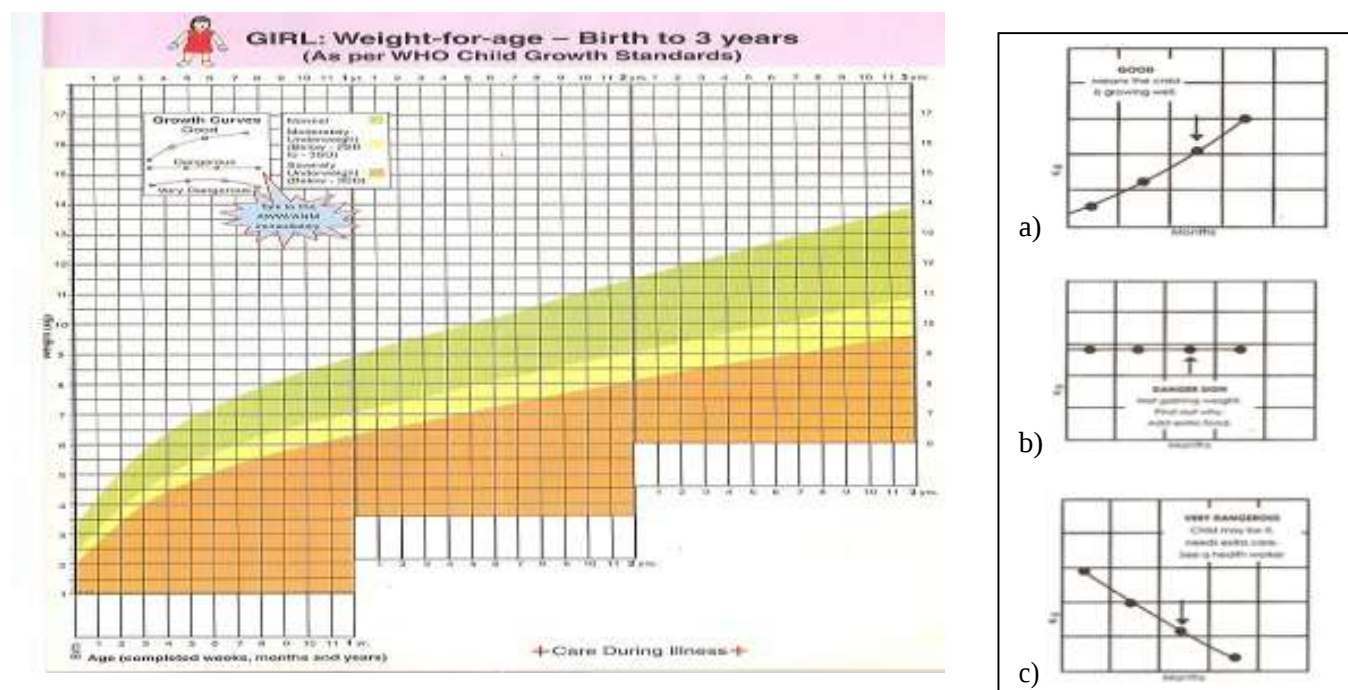


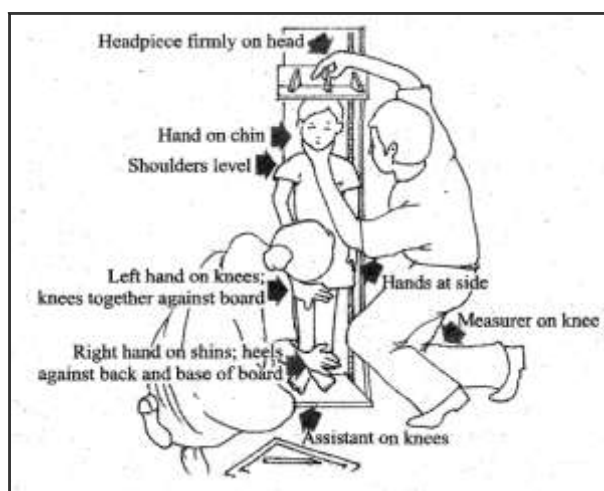
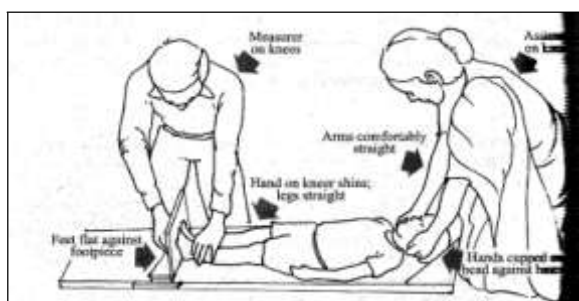
Figure 5: Growth Chart

If plotted weight-for-age of a child falls on green band, then the child's growth is NORMAL; if it falls on the yellow band, child is moderately underweight, and if the plotted weight is on the orange band, the child is severely underweight. The growth curve should continue to go up every time the child is weighed (as shown in (a) in the margin of figure 5). Straight or downward curve as shown in (b) and (c) in Figure 5 indicates poor growth and needs attention.

Next we move on to the second anthropometric measurement i.e. Height/Length.

ii) Length/Height for Age

Length or height is a commonly used measure to assess nutritional status. Length or height reflects the total increase in the size of the individual up to the moment it is determined. In case of infants and children less than 2 years of age length is measured known as crown heel length. The instrument used is called the Infantometer as illustrated in Figure 6. In case of children who are more than 2 years of age or in case of adult's standing height is measured. A portable anthropometric rod or tape can be used for measuring height.



a) Length measurement using Infantometer b) Anthropometry Rod

Figure 6: Height Measurement

But unlike weight, height changes very slowly to be used by itself to detect changes in growth pattern within a short time period. Hence it is not a very sensitive measure to assess short duration malnutrition. Height is affected by long term nutritional deprivation i.e. a deficiency of one or more nutrient over a long period of time, resulting in stunting - a low height for age. Stunting is consequence of chronic food deficiency. So if you come across a child who has low height for his age in all probability it reflects the cumulative effect of chronic food deficiency (particularly protein and energy insufficiency) and infection over a long period since and even before birth.

LOW HEIGHT FOR AGE is indicative of STUNTING and of chronic malnutrition

A third parameter used in anthropometry is Weight for Height measurement.

iii) Weight-for-Height

By relating the weight of a child to its height or length an objective measure of the child's degree of THINNESS can be obtained. Thinness indicates in most cases a recent and severe process of weight loss which is often associated with acute starvation or insufficient food intake and/or severe infection/disease such as diarrhoea, measles etc. So when weight of the child is low for the height it is called WASTING. Weight-for-Height is a very good index for short duration malnutrition, (like weight for age). Weight-for-Height Standards are available which are included in Annexure 1. In situations where accurate age assessment is not possible or required, this age-independent indicator can be used to assess nutritional status

LOW WEIGHT for HEIGHT is indicative of WASTING and of short duration malnutrition

So we have seen that weight, height and age together and weight and height independent of age are good indicators of child's nutritional status. Recent evidence (National Family Health Survey - 4 , 2015-16) suggests that 38.4% of Indian children under 5 years of age are stunted, 35.7% are underweight and 21% wasted, with 7.5% severely wasted as illustrated in Figure 7. Rural children are even worse off. as compared to urban children.

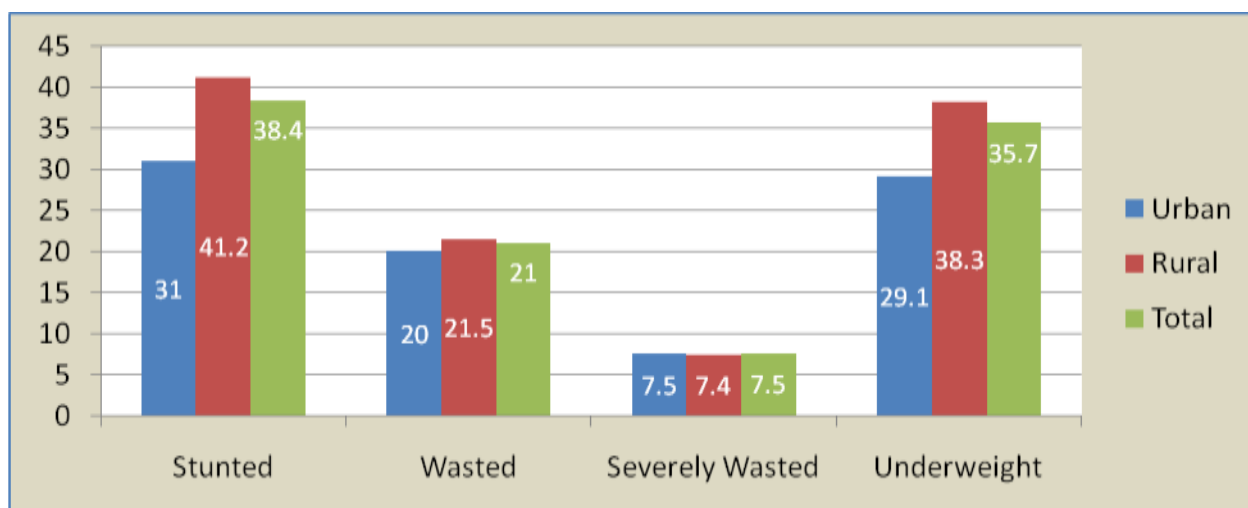


Figure 7: Nutritional status of Indian children under 5 years of age

Source: (NFHS-4, 2015-2016)

So far we have looked at anthropometric measurements for infants and young children. Next, a review of indices for adults and adolescents follows.

iv) Anthropometric Indices in Adults

In case of adults, Body Mass Index (BMI) is used to assess nutritional status. BMI is a simple index of weight-to-Height used to classify underweight, overweight and obesity in adults. BMI gives a measure of the body fat based on weight in relation to height and applies to most adult men and women aged 20 and over. BMI is defined as the weight (in kg) divided by the square of the Height in meters (kg/m^2).

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

For example if an adult women weigh's 60 kg and her height is 155 centimeters, then BMI for the women would be: $\text{BMI} = 60 / (1.55)^2 = 24.97 \text{ kg/m}^2$.

The BMI can be interpreted as under:

- ☐ BMI < 17.0 indicates moderate and severe thinness
- ☐ BMI < 18.5 indicates underweight
- ☐ BMI 18.5–24.9 indicates normal weight
- ☐ BMI $\geq$ 25.0 indicates overweight
- ☐ BMI $\geq$ 30.0 indicates obesity

Recent data suggests (NFHS 4, 2015-16) that 22.9% adult Indian women and 20.2 % adult men are underweight. On the other hand, 20.7% women and 18.9% men are overweight or obese. Evidence suggests that high BMI is associated with diabetes and high risk of cardiovascular morbidity and mortality.

iii) Nutritional Indices for Older Children and Adolescent

For children and adolescent, 5 to 19 years of age, BMI is used to assess nutritional status and calculated the same way as for adults. But here BMI is compared with typical values for other children of the same age and sex (WHO Growth Standards 2007). BMI is compared against the percentile for children of the same age and sex. Why? Because, in this group the body fat

changes with age and also the body fat differs between boys and girls. BMI- for-age percentile used to classify children and adolescent into different grades of malnutrition are given in Table 1.

Table 1: BMI for Age percentile for Children 5 to 19 years

BMI-for-Age Percentile	
Less than 5 th percentile	Underweight
5 th percentile to less than the 85 th percentile	Healthy weight
85 th percentile to less than the 95 th percentile	Risk of overweight
95 th percentile or greater	Overweight

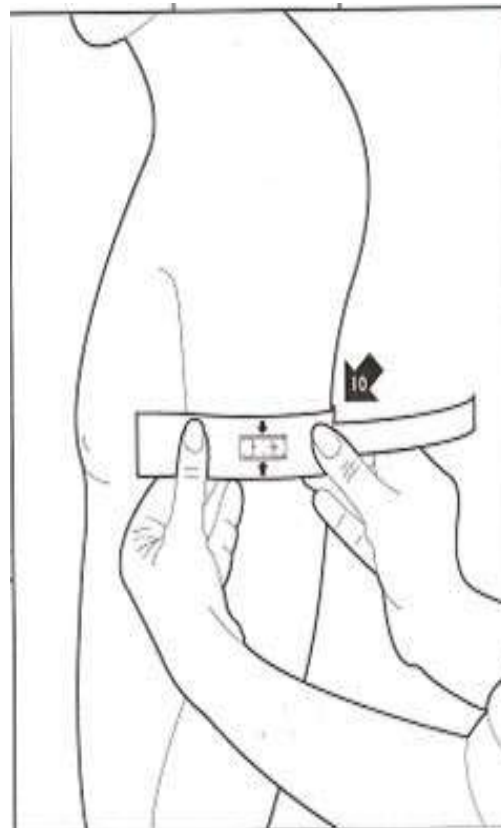
BMI-for-age Standards are given which are included in Annexure 1.

Information regarding other anthropometric measures such as body circumference measurements and body fat measurement is provided in Box 1, under Other Anthropometric Measurements heading.

BOX 1: OTHER ANTHROPOMETRIC MEASUREMENTS

Mid-Upper Arm circumference (MUAC) Measurements

Mid-upper arm circumference (MUAC) is commonly measured to assess nutrition status of infants and children. Arm circumference basically includes bone, fat and muscle. Arm circumference increases with age, but between one to five years it does not change much and remains fairly constant. So measuring the MUAC is useful in identifying malnutrition in Children. How? Fat and muscle, you might be aware, are the body's energy and protein reserve. These reserves are reduced in the body when there is not enough food or the body does not absorb the nutrients. So in children suffering from protein energy malnutrition, in early childhood, poor musculature and wasting is common features. Measuring the arm circumference, therefore, is a useful measure for assessing thinness or muscle wasting in children.



The arm circumference can be measured using flexible fibre glass tape and can be interpreted as under:

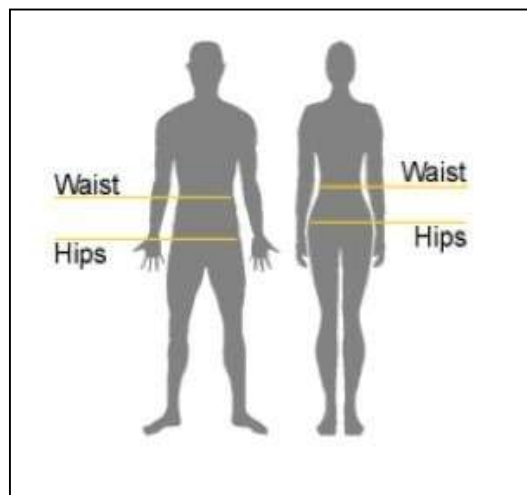
- ❑ MUAC less than 110mm (11.0cm), indicates Severe Acute Malnutrition (SAM). The child should be immediately referred for treatment.
- ❑ MUAC of between 110mm (11.0cm) and 125mm (12.5cm), indicates Moderate Acute Malnutrition (MAM). The child should be immediately referred for supplementation.
- ❑ MUAC of between 125mm (12.5cm) and 135mm (13.5cm), indicates that the child is at risk for acute malnutrition and should be counseled and followed-up with Growth Monitoring..
- ❑ MUAC over 135mm (13.5cm), indicates that the child is well nourished.

BOX 1: OTHER ANTHROPOMETRIC MEASUREMENTS

Waist and Hip Circumference Measurement

Waist circumference (WC) as a tool is used to assess abdominal fat and health status primarily in adults. WC predicts risk over and above that of BMI regarding which we learnt earlier. Waist is measured around the navel in a standing position using a flexible Non-stretchable tape.. Waist circumference at which there is a high risk of ill health is as follows:

HIGH RISK
Men: > 102 cm
Women : > 88cm



A high waist circumference indicates a high risk of obesity linked diseases such as type 2 diabetes, hypertension and Coronary Heart disease. Measuring hip circumference (along the widest portion of the hip) along with waist circumference and calculating the waist-hip ratio (WHR) is a good indicator of abdominal obesity.

$$\text{WHR} = \text{Waist}/\text{Hip}$$

According to World Health Organization. (WHO), a healthy WHR is:

- ☐ 0.9 or less in men, and
- ☐ 0.85 or less in women

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

Fat Fold Thickness: Assessment of Body Fat

Skinfold thickness measurements have been commonly used to determine percentage of body fat among individuals. We have learnt earlier that BMI provides a simple and useful population- level measure of body fat for all ages of adults. However it can only be considered as a rough guide because it may not correspond to the same body fat percentage in different individuals. Fat distribution in and around the body varies with age, sex, nutritional and health status and ethnicity. BMI does not measure fat directly but relies only on body weight and height and does not take into account overall body composition including body fat, muscle. So under conditions when there is insufficient intake of calories over a long period of time there is reduction in the thickness of the fat layer under the skin. Alternatively when there is excessive intake over a long period of time there can be accumulation of fat under the skin.

Skinfold measurement, therefore, is a simple means of measuring subcutaneous fat i.e. fat under the skin, which is also known as a skinfold thickness and is indicative of fat or fat reserves in the body. Fat fold can be measured at triceps (muscle found in the upper arm region), biceps, subscapular or suprailiac region. How can we measure skinfold thickness? Various kind of skinfold calipers are available for measuring skinfold thickness as highlighted in Figure.



B. Clinical Assessment

Clinical examination is one of the simplest and most practical methods used to assess nutritional deprivation. Nutritional deprivation here refers to deficiency of vitamins, minerals, proteins, energy and other nutrients. When there is nutritional deficiency it is associated with physical signs and symptoms what we refer to as clinical signs which can be valuable aids in detecting malnutrition. Clinical signs are changes (specific and non specific) in the body which are indicative of nutritional deficiency and/or excess. General clinical examination with special attention to organs like mouth, eyes, skin, nails, tongue, muscle, bone etc. is useful. Therefore knowledge of relevant signs and their detection helps in establishing nutritional diagnosis.

Table 2 presents some of the commonly occurring signs and symptoms of nutritional deprivation with their related body parts/system which can be used for the purpose of physical examination in nutritional surveys.

Table 2: -Physical signs indicative or suggestive of malnutrition

Body Area	Normal Appearance	Signs Associated with Malnutrition
General	Healthy and alert	Underweight/overweight, short stature, decreased activity level, wasting.
Hair	Shiny; firm; not easily plucked	Lack of natural shine; hair dull and dry; thin and sparse; depigmented, color changes (flag sign); can be easily plucked, altered texture
Face	Skin color uniform; smooth, pink, healthy appearance; not swollen	Skin color loss (depigmentation); skin dark over cheeks and under eyes; lumpiness or flakiness of skin of nose and mouth; swollen face; enlarged parotid glands; scaling of skin around nostrils
Eyes	Bright, clear, shiny; no sores at corners of eyelids; membrane healthy pink and moist.	Eye membranes are pale (pale conjunctivae); redness of membranes (conjunctival injection); Bitot's spots; redness and fissuring of eyelid corners; dryness of eye membranes; cornea has dull appearance; cornea is soft; scar on cornea.

Lips	Smooth, not chapped or swollen	Redness and swelling of mouth or lips (cheilosis); especially at corners of mouth (angular fissures and scars)
Tongue	Deep red in appearance; not swollen or smooth	Swelling; scarlet and raw tongue; magenta (purplish color) of tongue; smooth tongue; swollen sores; hyperemic and hypertrophic papillae; and atrophic papillae
Teeth	No cavities; no pain; bright	May be missing or erupting abnormally; gray or black spots (fluorosis); cavities (caries)
Gums	Healthy; red; do not bleed; not swollen	"Spongy" and bleed easily; recession of gums
Glands	Face not swollen	Thyroid enlargement (front of neck); parotid enlargement (cheeks become swollen)
Skin	No signs of rashes, swellings, dark or light spots	Dryness of skin; sandpaper feel of skin; flakiness of skin; skin swollen and dark; red swollen pigmentation of exposed areas; dermatitis in nasolabial folds, excessive lightness or darkness of skin; black and blue marks due to skin bleeding; lack of fat under skin
Nails	Firm, pink	Nails are spoon-shape (koilonychia); brittle, ridged nails
Muscular and skeletal systems	Good muscle tone; some fat under skin; can walk or run without pain	Muscles have "wasted" appearance; baby's skull bones are thin and soft; round swelling of front and side of head; swelling of ends of bones; small bumps on both sides of chest wall (on ribs)-beading of ribs; baby's soft spot on head does not harden at proper time; knock-knees or bow-legs; bleeding into muscle; person cannot get up or walk properly

Clinical assessment is fast and easy to perform, but the limitation is that they do not help in detecting early cases of deficiency as the signs and symptoms appear after prolonged biochemical changes have set in.

Next let us learn about biochemical assessment method of nutritional status.

C. Biochemical Assessment

Biochemical assessment i.e. laboratory tests based on blood and urine can be important indicators of nutritional status. Biochemical assessment deals with measuring the level of essential dietary constituents (i.e. nutrient concentration, metabolites) in the body fluids (normally blood and urine) which is helpful in evaluating the possibility of malnutrition. For example, Anemia is the most widespread of all the nutritional deficiencies found among individuals in our country. It is largely due to iron deficiency. So the measure of the haemoglobin (Hb) in the blood is helpful in evaluating the possibility of iron deficiency. Similarly a measure of the level of iodine in the urine reflects the iodine status in a community. Also stool examination for the presence of ova and/or intestinal parasites gives useful information.

The advantages of using biochemical assessment are that it is useful in detecting early changes in body metabolism or nutritional status much before the appearance of overt clinical signs and symptoms. It is precise and accurate. But it can be time consuming and expensive. It requires trained personnel and facilities.

D. Dietary Assessment

From our study so far it must be clear that diet or food intake is a major life-style factor which influences our nutritional status. Dietary assessment, therefore involves reviewing the intake of food and the nutrients and comparing the amount consumed with reference value to see whether deficiency or excess is likely. So 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 can be undertaken at an individual and/or family/household level. Dietary intake can be assessed by subjective self report such as food recall, diaries or food frequency questionnaires. Primarily, there are a wide range of methods used in diet surveys. At this stage it is not important to study each of these, but for your reference we have highlighted them in Box2.

BOX 2: METHODS OF DIET SURVEY

National level	Institutional level (Used for Hostel, hospital, Canteen, Jail, Orphanages etc.)	Family/Household Level	Individual Level
Food Balance Sheet (FBS)	- Inventory Method - Weighment Method	- Inventory Method - Weighment Method - Consumption Expenditure Survey	-Food Record or Diary -Diet history -24-hour dietary recall - Food Frequency Questionnaire

The 24-hour recall method is probably the most widely used method of dietary assessment. Based on a structured interview the person recalls food and beverage intake during the previous 24-hour period, most commonly, from midnight to midnight the previous day. The individual recalls what was eaten, how much was eaten, how was the food prepared, when was it eaten and other such details. To help the individual recall this information the interviewer/surveyor may carry standard measuring instruments such as cup, spoon, glass, bottle etc. Food models, pictures may also be used to help respondents judge and report portion size which helps improve accuracy. A schedule of 24-hour recall method of diet survey is available which is attached at Annexure 2 for kind reference. You can assess your 24-hour dietary intake using this schedule.

Yes while using this method you may have noticed that it is quick and easy and depends on short-term memory. But recording one day dietary intake only may not be truly representative of your usual, habitual intake. You may have eaten less or more on this day of assessment as compared to your usual pattern. Therefore, repeated 24-hour recalls i.e. dietary intake data for 2-3 consecutive days, preferably 2 working days and one holiday is recommended for more accurate data.

We end our study on dietary assessment here. We hope in this section you must have got a good review of the nutritional status assessment methods.

Going through this section you may have realized that children in our country are not in good health. Almost one third of our children are underweight, stunted and are at risk of death and disease/illness. At the global level too many children from other developing countries like India live under the Poverty line and have no access to health facilities, clean water, and good nutritious food to live a long healthy life. Towards this end a global initiative called Sustainable Development Goals have been adopted to set the tone and direction for development and aid for the next 15 years starting 2015. The last section in this Unit deals with SDG and also Human development Goals (HDI).

Before we move on to learn about these initiatives let us recall what we have learnt so far. Here we have included a knowledge assessment- 2 exercise. Attempt these questions and check your progress.

Knowledge Assessment – II

State True or False. Correct the false statement.

1. Weight-for-age is a very sensitive measure to assess long term malnutrition.
2. MUAC less than 12.5 cm indicates well nourished child.
3. A low Weight-for-height is indicative of Stunting.
4. Infantometer is the instrument used to measure length of children less than 2 years of age.
5. Growth monitoring is a simple tool used to assess the growth pattern of children using height and age.
6. BMI range between 18.5 to 24.9 indicates normal weight.
7. WHR less than 0.85 among women is indicative of abdominal obesity.
8. Clinical assessment deals with assessment of constituents in body fluids like blood and urine.
9. Nutrient deficiencies can lead to sign and symptom which can help diagnose malnutrition.
10. 24-hour recall method of dietary assessment is useful at an individual level.

Answers

1. False. Weight-for-age is sensitive measure to assess short term malnutrition.
2. False. MUAC less than 12.5 cm is indicative of undernutrition.
3. False. Low weight-for-height is indicative of Wasting.
4. True
5. False. Growth monitoring is a tool to assess growth pattern using weight for age indices.
6. True.
7. False. WHR more than 0.85 is indicative of abdominal obesity.
8. False. Biochemical assessment deals with assessing the constituents in body fluids.
9. True
10. True

SESSION 3: HUMAN DEVELOPMENT INDEX AND SUSTAINABLE DEVELOPMENT GOALS

Human Development Index (HDI): Basic Concepts

The Human Development Report (2016) released by the United Nation Development Programme (UNDP) ranks India 131 out of 188 countries. Every year UNDP ranks countries based on human development index. What is the Human development Index and how is it measured?

Human Development Index is a statistical tool which ranks countries by level of human development i.e. measure of a countries overall achievement in its social and economic dimensions. You may be wondering what these social and economic dimensions are? The social and economic dimensions of a country are based on: i) the health of the people, ii) level of education attainment, and iii) the standard of living. Refer to Figure 8.

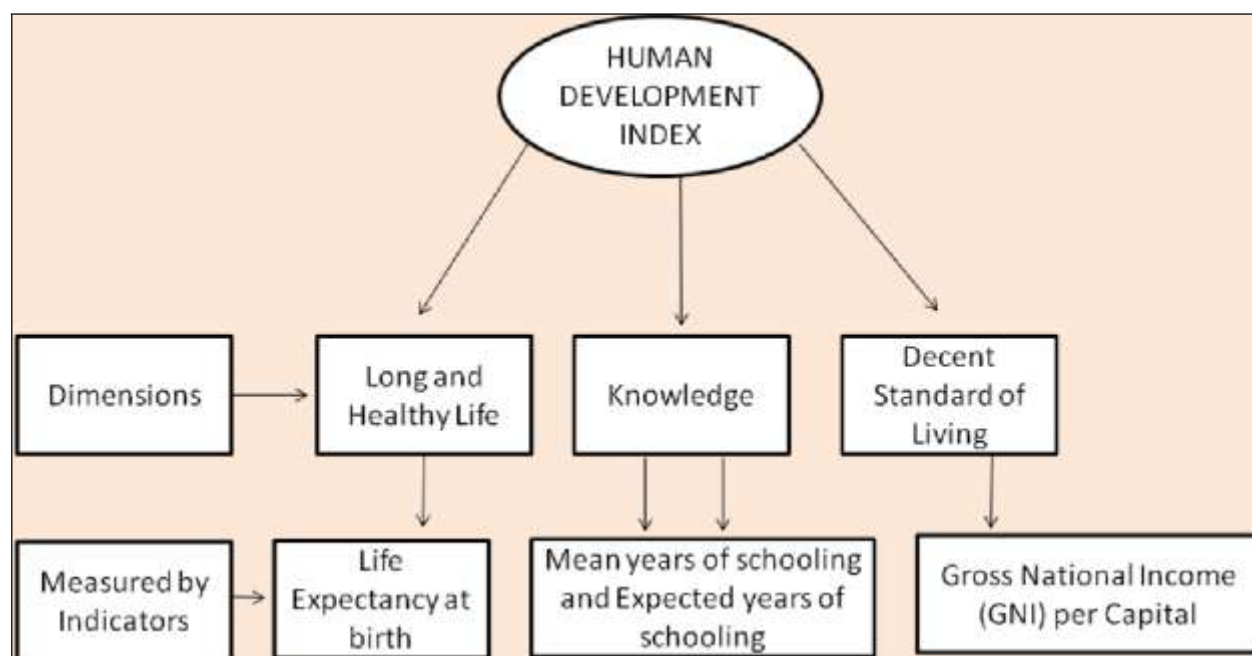


Figure 8: Components of human development index

The calculation of the human development index therefore combines four major indicators namely:

1. Life expectancy at birth: Number of years a new born infant could expect to live if prevailing pattern of age specific mortality rates at the time of birth stays the same throughout the infant's life.
2. Expected years of schooling for education:
3. Mean years for schooling for education: average number of years of education received by people age 25 and older, and
4. Gross National Income per Capita for Standard of living.

The HDI is a measure for assessing progress in human development based on a long and healthy life, access to knowledge and access to decent level of living. .These indicators are then combined to generate an HDI score between zero and one. India's human development index (HDI) value of 0.624 puts it in the "Medium Human development" category. The world's top three countries in HDI are Norway (0.949), Australia (0.939) and Switzerland (0.939).

The next topic of interest is Sustainable Development Goals (SDG). These goals are an attempt to galvanize global effort towards social mobilization for a healthy community. Let's get to know them.

Sustainable Development Goals (SDG's)

Many of you may have heard or read about the Millennium Development Goals (MDG's) which were the anti-poverty initiative set up in 2000 by United Nation. Eight goals were set out in this Millennium declaration adopted globally which was largely successful but many shortfalls remained in this 15 year effort.

The SDG's replace the MDG's. In September 2015, the United Nation (UN) General Assembly adopted the 2030 agenda for Sustainable Development. This new agenda emphasized a holistic approach to achieve sustainable development for all which included 17 goals featuring 169 targets to be implemented from 2015 to 2030. These goals are adopted by member countries of UN, including India.

What are these 17 Goals?

Refer to Figure 9 which illustrates these 17 goals. Having read the Goals you would have realized that all SDG's are interconnected. They are a universal call to end poverty.



Figure 9: Sustainable development goals

But as a student of Nutrition, the goals and targets which should concern us the most include the following three as also highlighted in Box 2.

Goal 2: End hunger;

Goal 3: Good Health and well-being; and

Goal 6: Clean Water and Sanitation.

The target of reducing by 2030, all forms of malnutrition, including stunting and wasting in children under 5 years of age, is critical for India.

BOX 2: TARGETS FOR GOAL 2, 3 AND 6

Goal 2: End Hunger

Achieve food security and improved nutrition and promote sustainable agriculture

TARGETS

- ☐ By 2030, end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round.
- ☐ By 2030, end all forms of malnutrition, including achieving by 2025, the internationally agreed targets on stunting and wasting in children under 5 years of age, and address the nutritional needs of adolescent girls, pregnant and lactating and older persons.

Goal 3: Good Health and Well Being

Ensure healthy lives and promote well-being for all ages

TARGETS

- ☐ By 2030 reduce the global maternal mortality ratio to less than 70 per 100000 live births
- ☐ By 2030 end preventable death of newborns and children under 5 years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1000 live births and under-5 mortality to at least as low as 25 per 1000 live births
- ☐ By 2030, end the epidemic of AIDS, tuberculosis, malaria and combat hepatitis, water borne diseases and other communicable diseases
- ☐ By 2030, reduce by one third premature mortality from non -communicable diseases through prevention and treatment and promote mental health and well-being.

Goal 6: Clean Water and Sanitation

Ensure availability and sustainable management of water sanitation for all

TARGETS

- ☐ By 2030, achieve universal and equitable access to safe and affordable drinking water for all
- ☐ By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations

The SDG index ranks countries based on their performance across all these 17 sustainable development goals. India's overall performance and SDG trends (2018) are highlighted in Figure 10.

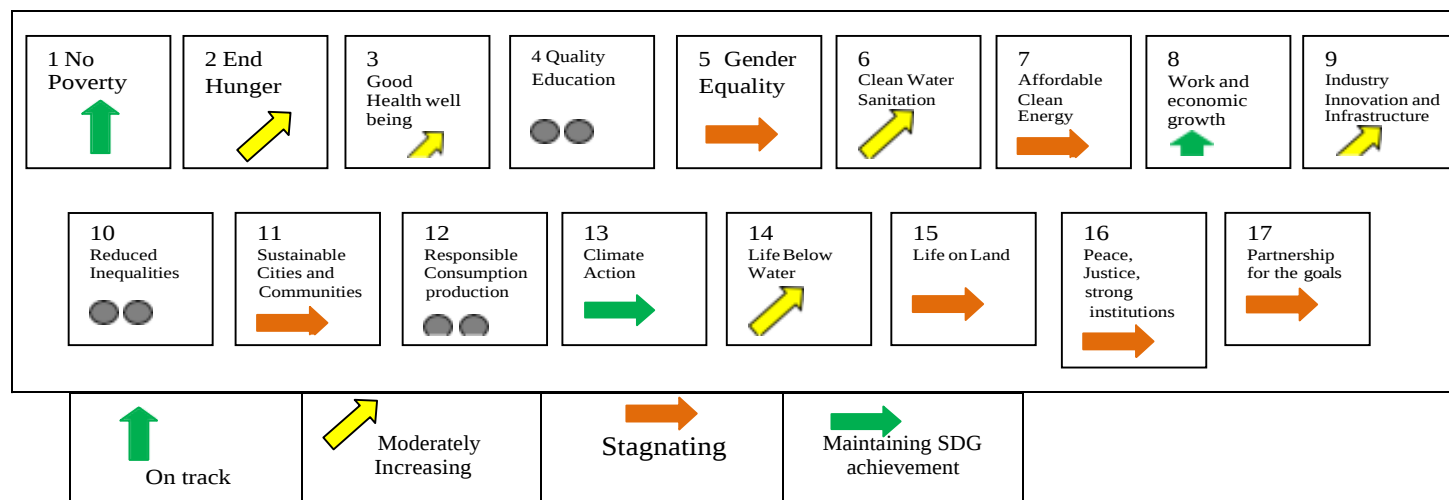


Figure 10: SDG trends in India

Source: SDG Index and Dashboard Report 2018

For Goals 2, 3 and 6 the trend depicted (refer to Figure 4) is a yellow moderately increasing line. This suggests that the score is increasing at a rate above 50% of the required growth rate but below the rate needed to achieve the SDG by 2030.

India is ranked 112 out of 156 nations on the SDG Index and Dashboard Report 2018.

To achieve these SDG's requires the partnership of Government, private sector, civil society and citizens alike to make sure we leave a better planet for our future generation.

UNIT: 3 - PUBLIC HEALTH AND NUTRITION: BASIC CONCEPT

Unit Code:	UNIT TITLE: PUBLIC HEALTH AND NUTRITION : BASIC CONCEPT			
	Duration:			
Location:	SESSION 1:PUBLIC HEALTH AND NUTRITION , MALNUTRITION : BASIC CONCEPTS			
Classroom or internet	Learning Outcome	Knowledge Evaluation	Performance Evaluation	Teaching and Training Method
	1. What is Public Health Nutrition	1. Explain the concept of public health nutrition 2. Enlist the activities related to public health nutrition	1. Analyse the concept of public health nutrition 2. State the various activities which a public health nutritionist may perform	Interactive Lecture: Introduction
	2. Malnutrition: Basic concept, Causes and Consequences	1. Define Malnutrition and its components 2. Discuss the various causes of Malnutrition 3.Highlight the consequences of malnutrition	1. Explain the meaning of malnutrition, undernutrition and overnutrition 2. Explain the immediate, underlying and basic causes of malnutrition 3. State the consequences of malnutrition	Interactive Lecture: Introduction .
	SESSION 2: METHOD OF ASSESSMENT OF NUTRITIONAL STATUS			
	1. Nutritional Status Assessment Methods	1. Define Nutritional status. 2. Enlist the methods of assessment of nutritional status	1. Explain the concept of ABCD, in the context of nutritional status assessment	Interactive Lecture: Acquaint methods nutritional status assessment
	2. Anthropometric measurements	1. Explain the meaning of anthropometry 2. Discuss the measures used in anthropometry 3. Explain the different anthropometric indices	1. Explain the importance of weight, height and other measures and indices in the context of anthropometric	Interactive Lecture: Discussion of the importance and Standards



		used for infants, young children, older children, adolescents and adults.	measurements 2. Categorize individuals into different grades of malnutrition 3. Calculate Body mass index and categorize individuals into different grades of malnutrition using BMI.	anthropometry Activity: Encourage children to take weight, height of their peer and compare with Standard values Calculate BMI and compare with Standards.
	3. Clinical, Biochemical and Dietary Assessment Methods	1. Explain the clinical assessment method and the various sign and symptoms used in clinical assessment 2. Explain the concept of biochemical assessment giving examples. 3. Discuss the use of Dietary assessment method 4. Explain the most common method of diet survey i.e. 24-hour-recall.	1. Identify various clinical sign and symptoms specific to nutrient deficiencies 2. Link sign, symptom of deficiencies to various body parts, organs. 3. Discuss the uses and limitations of biochemical assessment method Describe the use of dietary assessment method in the context of 24-hour recall method.	Interactive Lecture: Acquaint the students with the clinical sign and symptoms specific to deficiency condition Activity: Involve children in collecting pictures from internet, newspaper etc..of clinical sign, symptoms of deficiency diseases. Activity: Carry a 24-hour recall of the food eaten by the students in the last 24 hours.
1Location: Classroom or internet	SESSION 3: HUMAN DEVELOPMENT INDEX (HDI) AND SUSTAINABLE DEVELOPMENT GOALS (SDGs)			
	1.Human Development Index (HDI) 2.Sustainable Development Goals (SDGs)	1.Explain the concept of Human Development Index 2.Discuss the concept, significance of Sustainable development Goals. 3.Identify the three most important goals and their targets of SDGs in the context of public nutrition	1. Explain the components and indicators of HDI 2. Present the HDI score of India 3. List the three important goals in SDG (public health point of view) 4 Highlight the targets to be achieved and what is India's performance so far?	Interactive Lecture: Acquaint the students to the concept of HDI and SDGs.

UNIT: PUBLIC HEALTH AND NUTRITION: BASIC CONCEPTS

Learning Objectives:

After reading this unit, the students will be able to:

1. explain the concept of public health nutrition
2. define and discuss the various form of malnutrition
3. enlist the direct methods of nutritional status assessment
4. discuss the use and interpretation of anthropometric measurements
5. explain the clinical, biochemical and dietary assessment methods of nutritional status assessment
6. discuss human development index and its various components, and
7. state the sustainable development goals and their targets.

SESSION 1: PUBLIC HEALTH NUTRITION AND MALNUTRITION: BASIC CONCEPTS

We begin our study with a brief understanding of public health nutrition. What is public health nutrition and as a public health nutritionist what activities one would be involved with? Let's find out.

Public Health Nutrition: Basic Concept

Nutrition, as you may be aware, is one of the major determinants of the health and well-being of individuals in a society. So an area of study which emphasizes the application of food and nutrition knowledge, policy and research to the improvement of health of populations is called public health nutrition. It is primarily concerned with improving nutrition in population groups. Study of public health nutrition may, therefore, include an understanding of:

- ☐ the most critical social, behavioural and food and nutrition factors that affect health,
- ☐ nature, causes and consequences of nutrition problems, malnutrition in a society,
- ☐ nutritional requirements and dietary guidelines for populations,
- ☐ design, planning, implementation and evaluation of nutritional programmes and how they can improve the nutritional status of the population,

- ☐ how nutrition related and food related public policies affect health especially in vulnerable groups,
- ☐ Nutrition education for behaviour changes etc.

The activities mentioned above are by no means a complete list of activities undertaken within the public health nutrition domain. But surely they give you an idea about this area of study.

It may be emphasized that public health nutrition is a vast field and has many aspects to it. At this stage we are not required to dwell on these various activities.

Nutritional problems, malnutrition - their causes, consequences, you have learnt from a major part of study of public health nutrition. So let us begin our study of this unit with a review on the concept, definition, causes and consequences of malnutrition.

Malnutrition: Basic Concept, Causes and Consequences

When you think of malnutrition what picture comes to your mind? Yes very often we picture malnutrition as undernutrition. We tend to picture a thin starved individual as malnourished. Malnutrition, in fact is "poor nutrition". But what we fail to understand is that malnutrition is an impairment of health resulting not only from a deficiency or lack of food/nutrients but also when there is excess or imbalance of nutrients in the diet.

So when we talk of malnutrition we refer to both:

- ☐ Under nutrition: not getting enough nutrients, and
- ☐ Overnutrition: getting more nutrients than the body needs.

Figure 1 illustrates the concept:

Nutrients are essential substances present in food necessary of bodily functions including proteins, carbohydrates, fats, vitamins and minerals

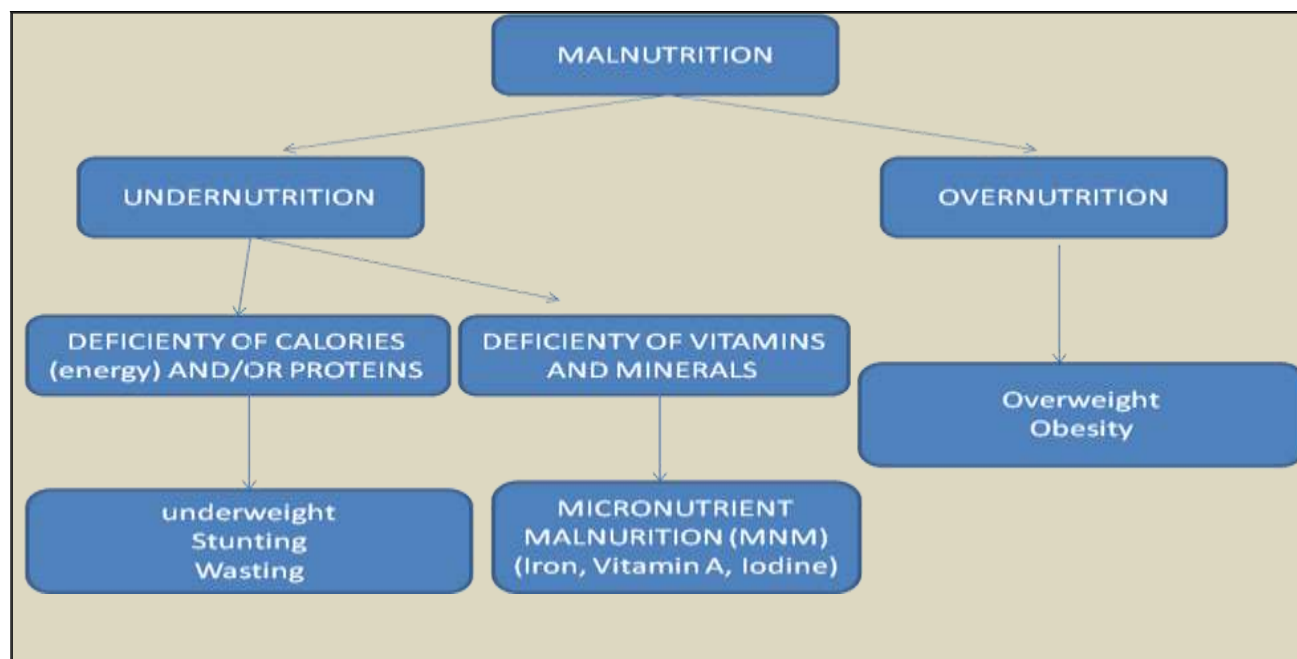


Figure 1: Malnutrition

Under nutrition is a condition which occurs when there is lack of adequate energy, protein and/or micronutrients (like iron, vitamin A etc.) in the diet. The basic requirement of nutrients for growth, development, body maintenance is not met leading to poor growth or protein energy malnutrition or deficiency diseases like anemia, permanent blindness etc. Overnutrition, on the other hand, is a form of malnutrition that occurs when we take more (or excess) of a nutrient than the body needs every day. Consumption of excess energy is an example of over nutrition leading to overweight or obesity. Overweight and obesity are defined as "abnormal or excessive fat accumulation that present a risk to health".

What are the factors contributing to malnutrition? Let us review.

Causes of Malnutrition

There can be many underlying causes of malnutrition. A conceptual framework on the causes of malnutrition was developed in 1990 by UNICEF. The framework shows that causes of malnutrition are multi-sectoral and classified as - Basic, underlying and Immediate as highlighted in Figure 2.

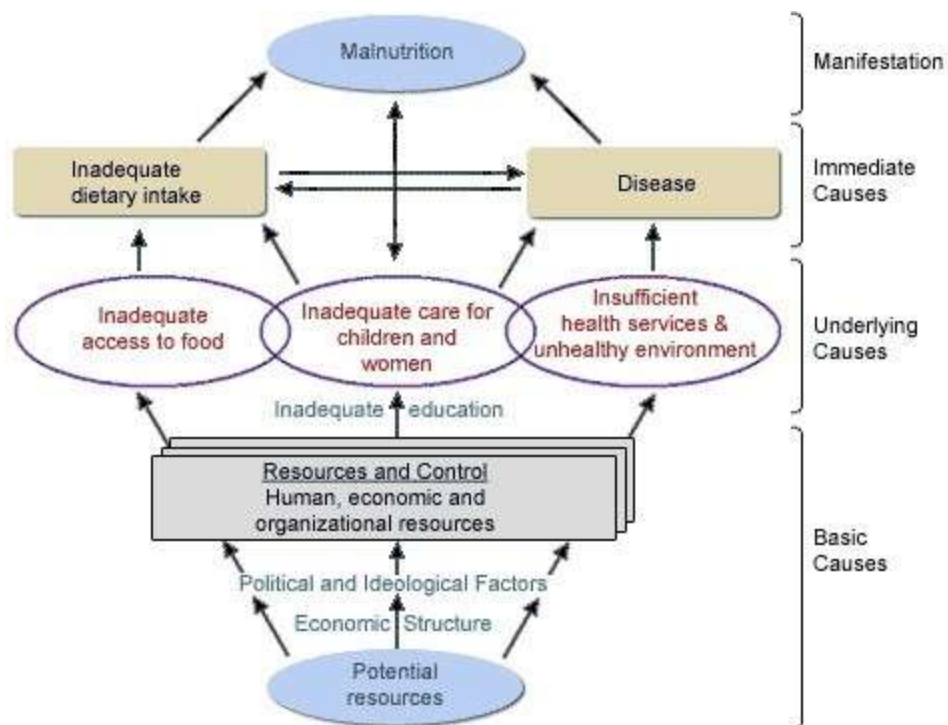


Figure 2: Causes of Malnutrition - UNICEF Framework

Immediate causes of malnutrition are at individual level including inadequate dietary intake and frequent illness and diseases. An individual's dietary intake and exposure to disease are affected by underlying factors at household/family level such as lack of availability of, access to and/or utilization of diverse diet, inadequate care and feeding practices for children combined with unhealthy household and surrounding environment and inaccessible and inadequate health care. Basic causes including the social, economical and political factors that neglect human rights, perpetuates poverty, denying the access of vulnerable populations to essential resources. These function at the Society level.

The causes of undernutrition and overnutrition are in many ways similar and interlinked. Factors such as poverty, lack of knowledge and access to adequate diet, poor infant and young child feeding practices, inadequate health care etc can lead to undernutrition as well as overweight and obesity.

Next let us get to know the consequences of malnutrition

Consequences of Malnutrition

The consequences linked with malnutrition can be devastating. Before we study the consequences let us get to know who are more likely to be suffering from malnutrition. Malnutrition affects first and foremost children under age of two, but young children under five years of age, adolescent, pregnant, lactating mothers, the elderly and the chronically ill are also vulnerable.

Malnutrition increases the risk of mortality (death) and morbidity (illness). In the long term chronic malnutrition during pregnancy and early childhood manifest as stunted growth (low height for age) and wasting (low weight for height). Children who are malnourished in the early years of life fail to grow and develop to their full potential, both physically and mentally. The consequences of stunting extend to adulthood increasing the risk of poor pregnancy outcome (i.e. the newborn is of low birth weight), impaired cognition that results in poor school performance, reduced economic productivity and earning. Stunted growth in early years increases the risk of overweight later in life and subsequently non communicable diseases such as cardiovascular diseases, diabetes, and hypertension.

Diets that are inadequate in terms of micronutrients (iron, iodine, Vitamin A) can lead to serious illness, including anaemia (iron deficiency), mental retardation and permanent blindness. People who suffer from malnutrition have fewer defenses against diseases i.e. have low immunity. They fall ill faster and easily and are less able to recover quickly and completely from the disease. Malnutrition increases the risk of infection and with infection there is reduced appetite, malabsorption which in turn increases the body's need for nutrients and leading to malnutrition creating a vicious cycle of malnutrition and infection.

Summary of the consequences of malnutrition are illustrated in Figure 3.

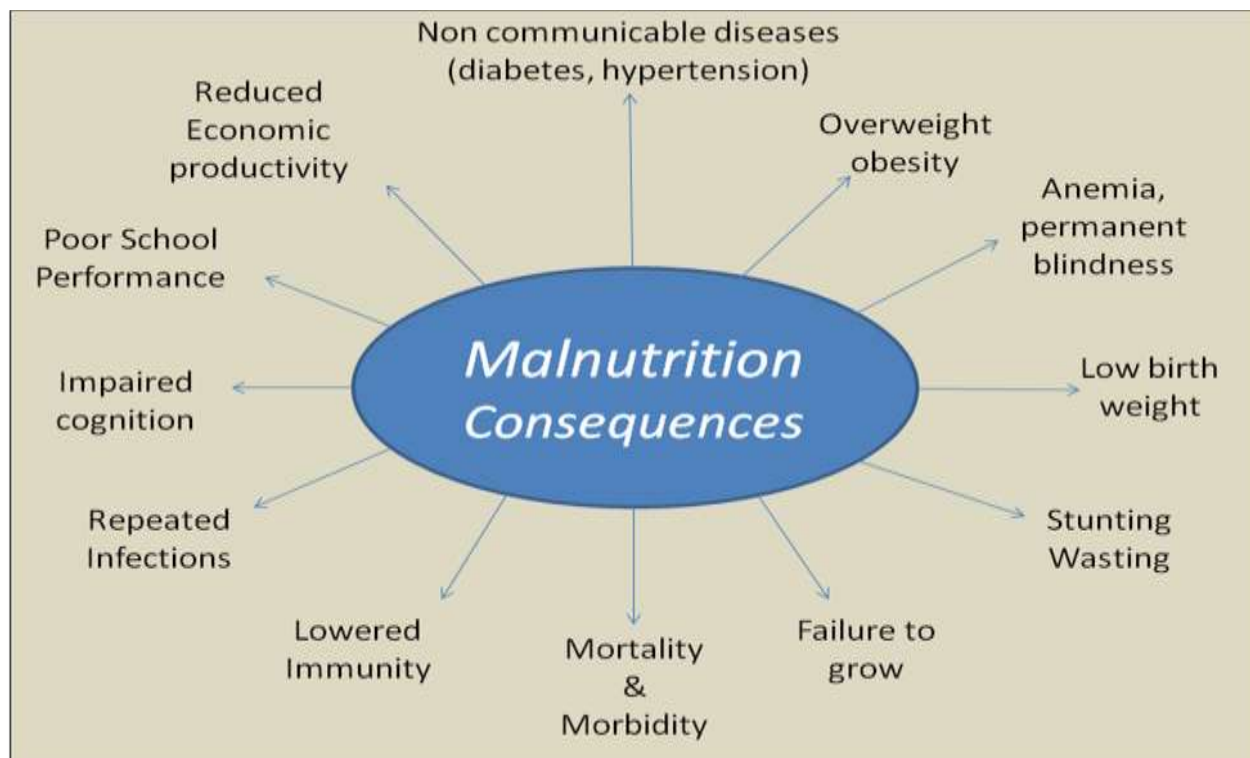


Figure 3: Consequences of malnutrition

Having considered the consequences of malnutrition it is important for us now as public health/nutrition students to be able to assess/identify individuals who are suffering from malnutrition or identify population groups or individuals who are at risk of malnutrition. How do we identify which individual is of optimal health, who is underweight or overweight or obese or suffering from a nutrient deficiency? How do we get to know the severity and magnitude of the nutritional problem? Are there any indicators? How do we assess the nutritional status? Our next section deals with this. But before we start the new section, here are few checks your progress exercises. Attempt the Knowledge Assessment -1.

KNOWLEDGE ASSESSMENT - 1

Fill in the blanks

1. Malnutrition refers to both ----- and----- .
2. The study which emphasizes the application of food and nutrition knowledge to the improvement of health and well being of individuals is called----- -- .
3. Abnormal or excessive fat accumulation that present a risk to health is called----- -- .
4. Diet inadequate in terms of the nutrient iron can lead to the deficiency condition called----- -- .
5. ----- and ----- are the immediate causes of malnutrition.

Answer: 1).undernutrition, obesity; 2) Public health nutrition; 3) obesity/overweight; 4) anaemia;
5) inadequate diet, diseases.

Multiple Choice Questions. (Read the statement and put a tick mark on the right answer).

1. Overweight is a consequence of:
 - a) deficiency of one or more nutrient
 - b) infections
 - c) excessive intake of energy
 - d) Both b and c
2. Underlying causes of malnutrition include:
 - a) Political factors
 - b) Illness and Disease
 - c) Inadequate care for women and children
 - d) Economic factors
3. Consequences of malnutrition include:
 - a) Lowered immunity
 - b) Poor productivity
 - c) Poor growth
 - d) All of the above
4. Non communicable diseases are consequences of:
 - a) Infections
 - b) Lowered immunity
 - c) Poor cognition
 - d) Overnutrition
5. Diabetes, Hypertension are an example of:
 - a) Infectious disease
 - b) Non communicable disease
 - c) Deficiency disease
 - d) None of the above

Answer: 1) - c; 2) - c; 3) - d; 4) - d; 5) - b.

SESSION 2: METHODS FOR ASSESSMENT OF NUTRITIONAL STATUS

Nutritional status of individuals is influenced by the diet (food intake) and the utilization of the nutrients but also by some internal external environmental factors. By studying these factors we can determine the nutritional status. Certain methods are used to assess nutritional status. We tend to classify them as direct methods and indirect methods. Here we will only focus on the Direct Methods of nutritional status assessment.

Nutritional status refers to the state of health of an individual as it is affected by the intake and utilization of nutrients (proteins, carbohydrates, fats, vitamins and minerals).

Direct methods used for assessment of nutritional status may be summarized as **ABCD**:

Anthropometric Measurements

Biochemical assessment

Clinical Methods, and

Dietary assessment

A. Anthropometric Measurements

The term Anthropometry literally means: Anthro = Man and Pometry = Measure

Anthropometry is the measurement of human body at various ages and level of nutritional status.

The most commonly used measurements include:

- Measurement of body weight,
- Measurement of standing height or crown heel length,
- Measurement of body circumferences, and
- Body fat (Skinfold measurement)

In children the three most commonly used anthropometric indices to assess their growth status are weight for age, Height/length for Age and Weight for Height. Let us briefly review each of these anthropometric indices.

i) Weight for Age

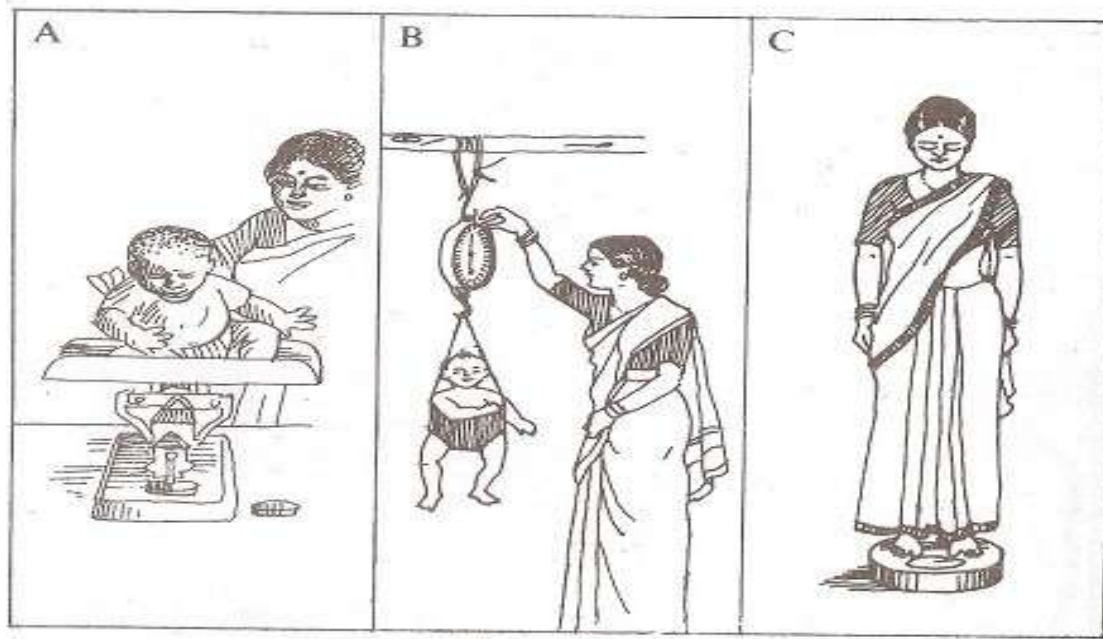
Body weight indicates body mass and is a composite of all body constituent such as water, mineral, fat, protein and bone. Repeated measurement of weight at regular period is a sensitive indicator of change in nutritional status. So any small changes or rapid changes in body weight of individuals, particularly children detected over a short period of time which may be due to poor diet and/or short duration illness and/or infection (such as diarrhoea) etc., indicates potential malnutrition. Weight is, therefore, indicative of short term malnutrition.

Along with weight, appropriate age assessment is also necessary for assessment of nutritional status. Why? Because we all know that body measures such as weight, height etc. increases with age. So if the correct age is not known it might not be possible to have an accurate assessment.

So Weight-for- Age is used as a measure of nutritional status. A low weight for age is referred to as underweight.

LOW WEIGHT FOR AGE is indicative of UNDERWEIGHT and of Short term malnutrition

Various types of weighing instruments are available to measure weight as highlighted in Figure 4.



a) Balance Beam

b) Spring Scale

c) Electronic scale

Figure 4: Weighing Scale

The next question then you may ask is how do we know that the actual weight measurement obtained for an individual is normal or appropriate for his/her age? For this we need to compare the actual obtained weight with a set of values called STANDARDS. In India for children we use the WHO GROWTH Standards (2006) to compare the data. These Standards are primarily average body measurements of well nourished and healthy children (belonging to well-to-do-society) who are medically and socially well protected and these values are used for purpose of comparison. Tables providing the WHO Standard measurements are given in Annexure 1 at the end of this unit for your reference.

Alternatively weight obtained can be plotted against age on a graph/chart so that growth pattern can be followed graphically in comparison to reference standards. This process is called Growth Monitoring. The charts used are Growth Charts which are designed as a means of monitoring and interpreting changes in weight over time. Refer to Figure 5 which illustrates the Growth chart

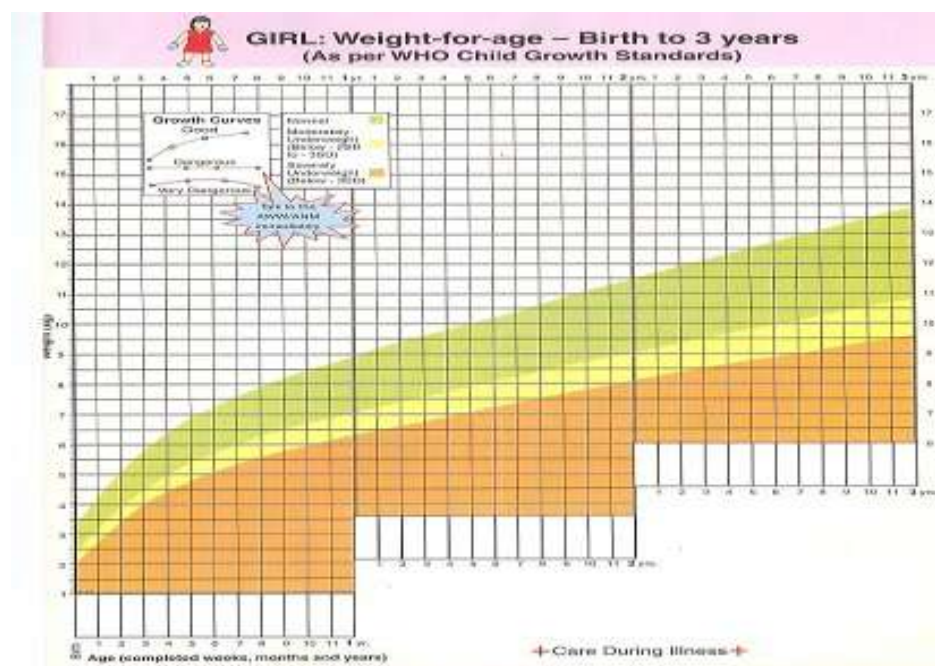
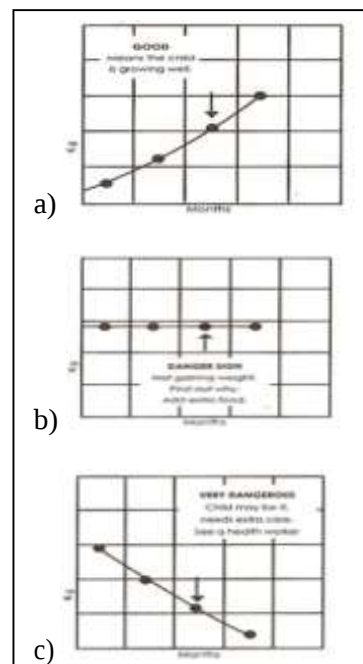


Figure 5: Growth Chart

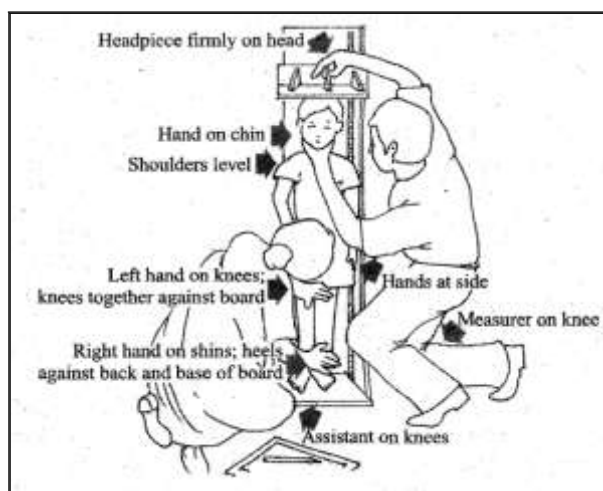
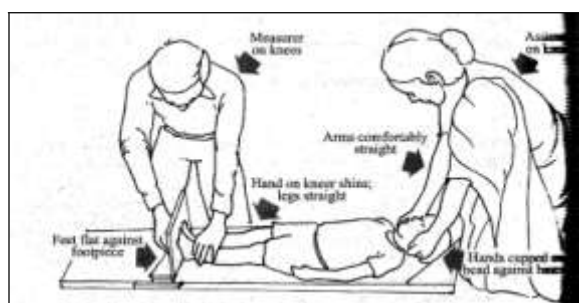
If plotted weight-for-age of a child falls on green band, then the child's growth is NORMAL; if it falls on the yellow band, child is moderately underweight, and if the plotted weight is on the orange band, the child is severely underweight. The growth curve should continue to go up every time the child is weighed (as shown in (a) in the margin of figure 5). Straight or downward curve as shown in (b) and (c) in Figure 5 indicates poor growth and needs attention.



Next we move on to the second anthropometric measurement i.e. Height/Length.

ii) Length/Height for Age

Length or height is a commonly used measure to assess nutritional status. Length or height reflects the total increase in the size of the individual up to the moment it is determined. In case of infants and children less than 2 years of age length is measured known as crown heel length. The instrument used is called the Infantometer as illustrated in Figure 6. In case of children who are more than 2 years of age or in case of adult's standing height is measured. A portable anthropometric rod or tape can be used for measuring height.



a) Length measurement using Infantometer b) Anthropometry Rod

Figure 6: Height Measurement

But unlike weight, height changes very slowly to be used by itself to detect changes in growth pattern within a short time period. Hence it is not a very sensitive measure to assess short duration malnutrition. Height is affected by long term nutritional deprivation i.e. a deficiency of one or more nutrient over a long period of time, resulting in stunting - a low height for age. Stunting is consequence of chronic food deficiency. So if you come across a child who has low height for his age in all probability it reflects the cumulative effect of chronic food deficiency (particularly protein and energy insufficiency) and infection over a long period since and even before birth.

LOW HEIGHT FOR AGE is indicative of STUNTING and of chronic malnutrition

A third parameter used in anthropometry is Weight for Height measurement.

iii) Weight-for-Height

By relating the weight of a child to its height or length an objective measure of the child's degree of THINNESS can be obtained. Thinness indicates in most cases a recent and severe process of weight loss which is often associated with acute starvation or insufficient food intake and/or severe infection/disease such as diarrhoea, measles etc. So when weight of the child is low for the height it is called WASTING. Weight-for-Height is a very good index for short duration malnutrition, (like weight for age). Weight-for-Height Standards are available which are included in Annexure 1. In situations where accurate age assessment is not possible or required, this age-independent indicator can be used to assess nutritional status

LOW WEIGHT for HEIGHT is indicative of WASTING and of short duration malnutrition

So we have seen that weight, height and age together and weight and height independent of age are good indicators of child's nutritional status. Recent evidence (National Family Health Survey - 4 , 2015-16) suggests that 38.4% of Indian children under 5 years of age are stunted, 35.7% are underweight and 21% wasted, with 7.5% severely wasted as illustrated in Figure 7. Rural children are even worse off, as compared to urban children.

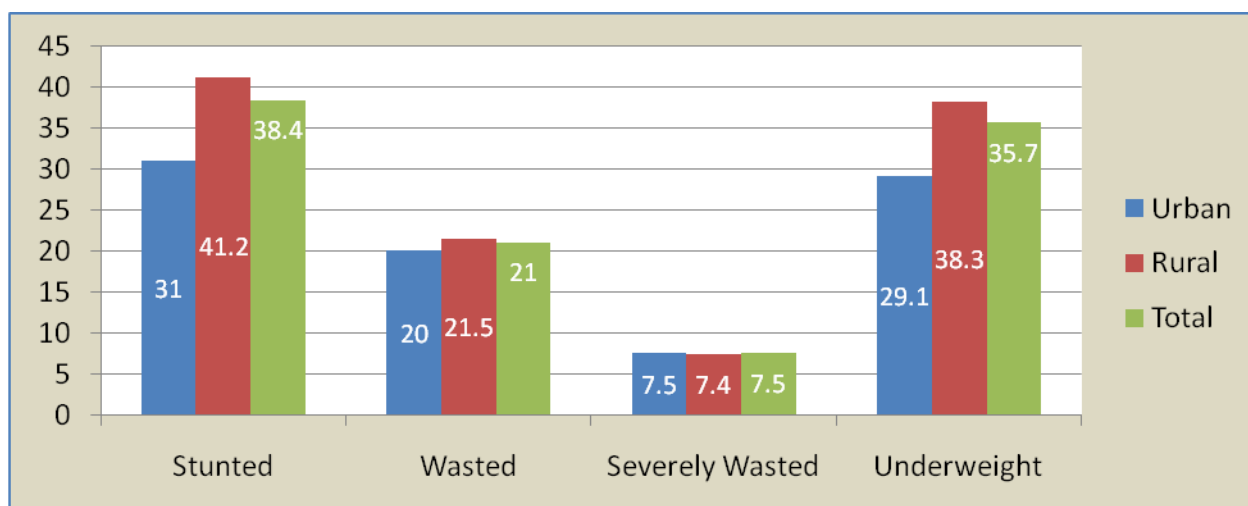


Figure 7: Nutritional status of Indian children under 5 years of age

Source: (NFHS-4, 2015-2016)

So far we have looked at anthropometric measurements for infants and young children. Next, a review of indices for adults and adolescents follows.

iv) Anthropometric Indices in Adults

In case of adults, Body Mass Index (BMI) is used to assess nutritional status. BMI is a simple index of weight-to-Height used to classify underweight, overweight and obesity in adults. BMI gives a measure of the body fat based on weight in relation to height and applies to most adult men and women aged 20 and over. BMI is defined as the weight (in kg) divided by the square of the Height in meters (kg/m^2).

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

For example if an adult women weigh's 60 kg and her height is 155 centimeters, then BMI for the women would be: $\text{BMI} = 60 / (1.55)^2 = 24.97 \text{ kg/m}^2$.

The BMI can be interpreted as under:

- ☐ BMI < 17.0 indicates moderate and severe thinness
- ☐ BMI < 18.5 indicates underweight
- ☐ BMI 18.5–24.9 indicates normal weight
- ☐ BMI $\geq$ 25.0 indicates overweight
- ☐ BMI $\geq$ 30.0 indicates obesity

Recent data suggests (NFHS 4, 2015-16) that 22.9% adult Indian women and 20.2 % adult men are underweight. On the other hand, 20.7% women and 18.9% men are overweight or obese. Evidence suggests that high BMI is associated with diabetes and high risk of cardiovascular morbidity and mortality.

iii) Nutritional Indices for Older Children and Adolescent

For children and adolescent, 5 to 19 years of age, BMI is used to assess nutritional status and calculated the same way as for adults. But here BMI is compared with typical values for other children of the same age and sex (WHO Growth Standards 2007). BMI is compared against the percentile for children of the same age and sex. Why? Because, in this group the body fat

changes with age and also the body fat differs between boys and girls. BMI- for-age percentile used to classify children and adolescent into different grades of malnutrition are given in Table 1.

Table 1: BMI for Age percentile for Children 5 to 19 years

BMI-for-Age Percentile	
Less than 5 th percentile	Underweight
5 th percentile to less than the 85 th percentile	Healthy weight
85 th percentile to less than the 95 th percentile	Risk of overweight
95 th percentile or greater	Overweight

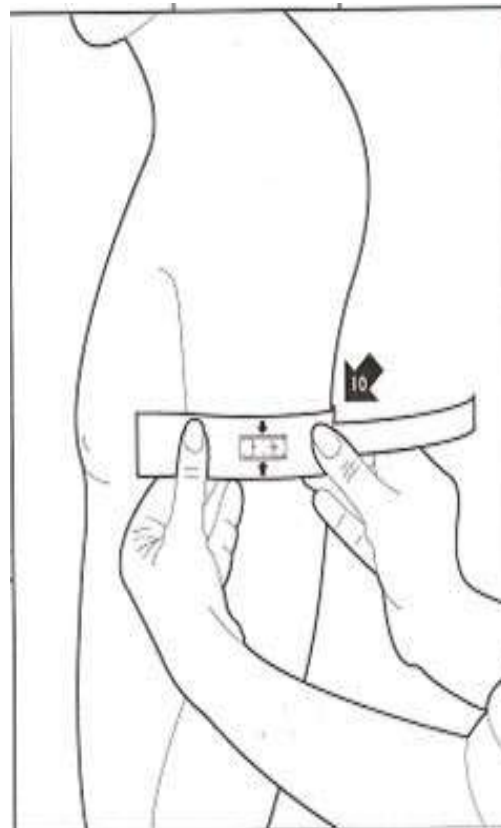
BMI-for-age Standards are given which are included in Annexure 1.

Information regarding other anthropometric measures such as body circumference measurements and body fat measurement is provided in Box 1, under Other Anthropometric Measurements heading.

BOX 1: OTHER ANTHROPOMETRIC MEASUREMENTS

Mid-Upper Arm circumference (MUAC) Measurements

Mid-upper arm circumference (MUAC) is commonly measured to assess nutrition status of infants and children. Arm circumference basically includes bone, fat and muscle. Arm circumference increases with age, but between one to five years it does not change much and remains fairly constant. So measuring the MUAC is useful in identifying malnutrition in Children. How? Fat and muscle, you might be aware, are the body's energy and protein reserve. These reserves are reduced in the body when there is not enough food or the body does not absorb the nutrients. So in children suffering from protein energy malnutrition, in early childhood, poor musculature and wasting is common features. Measuring the arm circumference, therefore, is a useful measure for assessing thinness or muscle wasting in children.



The arm circumference can be measured using flexible fibre glass tape and can be interpreted as under:

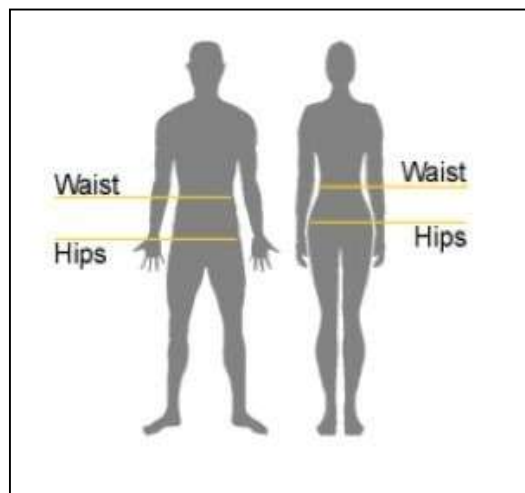
- ❑ MUAC less than 110mm (11.0cm), indicates Severe Acute Malnutrition (SAM). The child should be immediately referred for treatment.
- ❑ MUAC of between 110mm (11.0cm) and 125mm (12.5cm), indicates Moderate Acute Malnutrition (MAM). The child should be immediately referred for supplementation.
- ❑ MUAC of between 125mm (12.5cm) and 135mm (13.5cm), indicates that the child is at risk for acute malnutrition and should be counseled and followed-up with Growth Monitoring..
- ❑ MUAC over 135mm (13.5cm), indicates that the child is well nourished.

BOX 1: OTHER ANTHROPOMETRIC MEASUREMENTS

Waist and Hip Circumference Measurement

Waist circumference (WC) as a tool is used to assess abdominal fat and health status primarily in adults. WC predicts risk over and above that of BMI regarding which we learnt earlier. Waist is measured around the navel in a standing position using a flexible Non-stretchable tape.. Waist circumference at which there is a high risk of ill health is as follows:

HIGH RISK
Men: > 102 cm
Women : > 88cm



A high waist circumference indicates a high risk of obesity linked diseases such as type 2 diabetes, hypertension and Coronary Heart disease. Measuring hip circumference (along the widest portion of the hip) along with waist circumference and calculating the waist-hip ratio (WHR) is a good indicator of abdominal obesity.

$$\text{WHR} = \text{Waist}/\text{Hip}$$

According to World Health Organization. (WHO), a healthy WHR is:

- ☐ 0.9 or less in men, and
- ☐ 0.85 or less in women

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

Fat Fold Thickness: Assessment of Body Fat

Skinfold thickness measurements have been commonly used to determine percentage of body fat among individuals. We have learnt earlier that BMI provides a simple and useful population- level measure of body fat for all ages of adults. However it can only be considered as a rough guide because it may not correspond to the same body fat percentage in different individuals. Fat distribution in and around the body varies with age, sex, nutritional and health status and ethnicity. BMI does not measure fat directly but relies only on body weight and height and does not take into account overall body composition including body fat, muscle. So under conditions when there is insufficient intake of calories over a long period of time there is reduction in the thickness of the fat layer under the skin. Alternatively when there is excessive intake over a long period of time there can be accumulation of fat under the skin.

Skinfold measurement, therefore, is a simple means of measuring subcutaneous fat i.e. fat under the skin, which is also known as a skinfold thickness and is indicative of fat or fat reserves in the body. Fat fold can be measured at triceps (muscle found in the upper arm region), biceps, subscapular or suprailiac region. How can we measure skinfold thickness? Various kind of skinfold calipers are available for measuring skinfold thickness as highlighted in Figure.



B. Clinical Assessment

Clinical examination is one of the simplest and most practical methods used to assess nutritional deprivation. Nutritional deprivation here refers to deficiency of vitamins, minerals, proteins, energy and other nutrients. When there is nutritional deficiency it is associated with physical signs and symptoms what we refer to as clinical signs which can be valuable aids in detecting malnutrition. Clinical signs are changes (specific and non specific) in the body which are indicative of nutritional deficiency and/or excess. General clinical examination with special attention to organs like mouth, eyes, skin, nails, tongue, muscle, bone etc. is useful. Therefore knowledge of relevant signs and their detection helps in establishing nutritional diagnosis.

Table 2 presents some of the commonly occurring signs and symptoms of nutritional deprivation with their related body parts/system which can be used for the purpose of physical examination in nutritional surveys.

Table 2: -Physical signs indicative or suggestive of malnutrition

Body Area	Normal Appearance	Signs Associated with Malnutrition
General	Healthy and alert	Underweight/overweight, short stature, decreased activity level, wasting.
Hair	Shiny; firm; not easily plucked	Lack of natural shine; hair dull and dry; thin and sparse; depigmented, color changes (flag sign); can be easily plucked, altered texture
Face	Skin color uniform; smooth, pink, healthy appearance; not swollen	Skin color loss (depigmentation); skin dark over cheeks and under eyes; lumpiness or flakiness of skin of nose and mouth; swollen face; enlarged parotid glands; scaling of skin around nostrils
Eyes	Bright, clear, shiny; no sores at corners of eyelids; membrane healthy pink and moist.	Eye membranes are pale (pale conjunctivae); redness of membranes (conjunctival injection); Bitot's spots; redness and fissuring of eyelid corners; dryness of eye membranes; cornea has dull appearance; cornea is soft; scar on cornea.

Lips	Smooth, not chapped or swollen	Redness and swelling of mouth or lips (cheilosis); especially at corners of mouth (angular fissures and scars)
Tongue	Deep red in appearance; not swollen or smooth	Swelling; scarlet and raw tongue; magenta (purplish color) of tongue; smooth tongue; swollen sores; hyperemic and hypertrophic papillae; and atrophic papillae
Teeth	No cavities; no pain; bright	May be missing or erupting abnormally; gray or black spots (fluorosis); cavities (caries)
Gums	Healthy; red; do not bleed; not swollen	"Spongy" and bleed easily; recession of gums
Glands	Face not swollen	Thyroid enlargement (front of neck); parotid enlargement (cheeks become swollen)
Skin	No signs of rashes, swellings, dark or light spots	Dryness of skin; sandpaper feel of skin; flakiness of skin; skin swollen and dark; red swollen pigmentation of exposed areas; dermatitis in nasolabial folds, excessive lightness or darkness of skin; black and blue marks due to skin bleeding; lack of fat under skin
Nails	Firm, pink	Nails are spoon-shape (koilonychia); brittle, ridged nails
Muscular and skeletal systems	Good muscle tone; some fat under skin; can walk or run without pain	Muscles have "wasted" appearance; baby's skull bones are thin and soft; round swelling of front and side of head; swelling of ends of bones; small bumps on both sides of chest wall (on ribs)-beading of ribs; baby's soft spot on head does not harden at proper time; knock-knees or bow-legs; bleeding into muscle; person cannot get up or walk properly

Clinical assessment is fast and easy to perform, but the limitation is that they do not help in detecting early cases of deficiency as the signs and symptoms appear after prolonged biochemical changes have set in.

Next let us learn about biochemical assessment method of nutritional status.

C. Biochemical Assessment

Biochemical assessment i.e. laboratory tests based on blood and urine can be important indicators of nutritional status. Biochemical assessment deals with measuring the level of essential dietary constituents (i.e. nutrient concentration, metabolites) in the body fluids (normally blood and urine) which is helpful in evaluating the possibility of malnutrition. For example, Anemia is the most widespread of all the nutritional deficiencies found among individuals in our country. It is largely due to iron deficiency. So the measure of the haemoglobin (Hb) in the blood is helpful in evaluating the possibility of iron deficiency. Similarly a measure of the level of iodine in the urine reflects the iodine status in a community. Also stool examination for the presence of ova and/or intestinal parasites gives useful information.

The advantages of using biochemical assessment are that it is useful in detecting early changes in body metabolism or nutritional status much before the appearance of overt clinical signs and symptoms. It is precise and accurate. But it can be time consuming and expensive. It requires trained personnel and facilities.

D. Dietary Assessment

From our study so far it must be clear that diet or food intake is a major life-style factor which influences our nutritional status. Dietary assessment, therefore involves reviewing the intake of food and the nutrients and comparing the amount consumed with reference value to see whether deficiency or excess is likely. So 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 can be undertaken at an individual and/or family/household level. Dietary intake can be assessed by subjective self report such as food recall, diaries or food frequency questionnaires. Primarily, there are a wide range of methods used in diet surveys. At this stage it is not important to study each of these, but for your reference we have highlighted them in Box2.

BOX 2: METHODS OF DIET SURVEY

National level	Institutional level (Used for Hostel, hospital, Canteen, Jail, Orphanages etc.)	Family/Household Level	Individual Level
Food Balance Sheet (FBS)	- Inventory Method - Weighment Method	- Inventory Method - Weighment Method - Consumption Expenditure Survey	-Food Record or Diary -Diet history -24-hour dietary recall - Food Frequency Questionnaire

The 24-hour recall method is probably the most widely used method of dietary assessment. Based on a structured interview the person recalls food and beverage intake during the previous 24-hour period, most commonly, from midnight to midnight the previous day. The individual recalls what was eaten, how much was eaten, how was the food prepared, when was it eaten and other such details. To help the individual recall this information the interviewer/surveyor may carry standard measuring instruments such as cup, spoon, glass, bottle etc. Food models, pictures may also be used to help respondents judge and report portion size which helps improve accuracy. A schedule of 24-hour recall method of diet survey is available which is attached at Annexure 2 for kind reference. You can assess your 24-hour dietary intake using this schedule.

Yes while using this method you may have noticed that it is quick and easy and depends on short-term memory. But recording one day dietary intake only may not be truly representative of your usual, habitual intake. You may have eaten less or more on this day of assessment as compared to your usual pattern. Therefore, repeated 24-hour recalls i.e. dietary intake data for 2-3 consecutive days, preferably 2 working days and one holiday is recommended for more accurate data.

We end our study on dietary assessment here. We hope in this section you must have got a good review of the nutritional status assessment methods.

Going through this section you may have realized that children in our country are not in good health. Almost one third of our children are underweight, stunted and are at risk of death and disease/illness. At the global level too many children from other developing countries like India live under the Poverty line and have no access to health facilities, clean water, and good nutritious food to live a long healthy life. Towards this end a global initiative called Sustainable Development Goals have been adopted to set the tone and direction for development and aid for the next 15 years starting 2015. The last section in this Unit deals with SDG and also Human development Goals (HDI).

Before we move on to learn about these initiatives let us recall what we have learnt so far. Here we have included a knowledge assessment- 2 exercise. Attempt these questions and check your progress.

Knowledge Assessment – II

State True or False. Correct the false statement.

1. Weight-for-age is a very sensitive measure to assess long term malnutrition.
2. MUAC less than 12.5 cm indicates well nourished child.
3. A low Weight-for-height is indicative of Stunting.
4. Infantometer is the instrument used to measure length of children less than 2 years of age.
5. Growth monitoring is a simple tool used to assess the growth pattern of children using height and age.
6. BMI range between 18.5 to 24.9 indicates normal weight.
7. WHR less than 0.85 among women is indicative of abdominal obesity.
8. Clinical assessment deals with assessment of constituents in body fluids like blood and urine.
9. Nutrient deficiencies can lead to sign and symptom which can help diagnose malnutrition.
10. 24-hour recall method of dietary assessment is useful at an individual level.

Answers

1. False. Weight-for-age is sensitive measure to assess short term malnutrition.
2. False. MUAC less than 12.5 cm is indicative of undernutrition.
3. False. Low weight-for-height is indicative of Wasting.
4. True
5. False. Growth monitoring is a tool to assess growth pattern using weight for age indices.
6. True.
7. False. WHR more than 0.85 is indicative of abdominal obesity.
8. False. Biochemical assessment deals with assessing the constituents in body fluids.
9. True
10. True

SESSION 3: HUMAN DEVELOPMENT INDEX AND SUSTAINABLE DEVELOPMENT GOALS

Human Development Index (HDI): Basic Concepts

The Human Development Report (2016) released by the United Nation Development Programme (UNDP) ranks India 131 out of 188 countries. Every year UNDP ranks countries based on human development index. What is the Human development Index and how is it measured?

Human Development Index is a statistical tool which ranks countries by level of human development i.e. measure of a countries overall achievement in its social and economic dimensions. You may be wondering what these social and economic dimensions are? The social and economic dimensions of a country are based on: i) the health of the people, ii) level of education attainment, and iii) the standard of living. Refer to Figure 8.

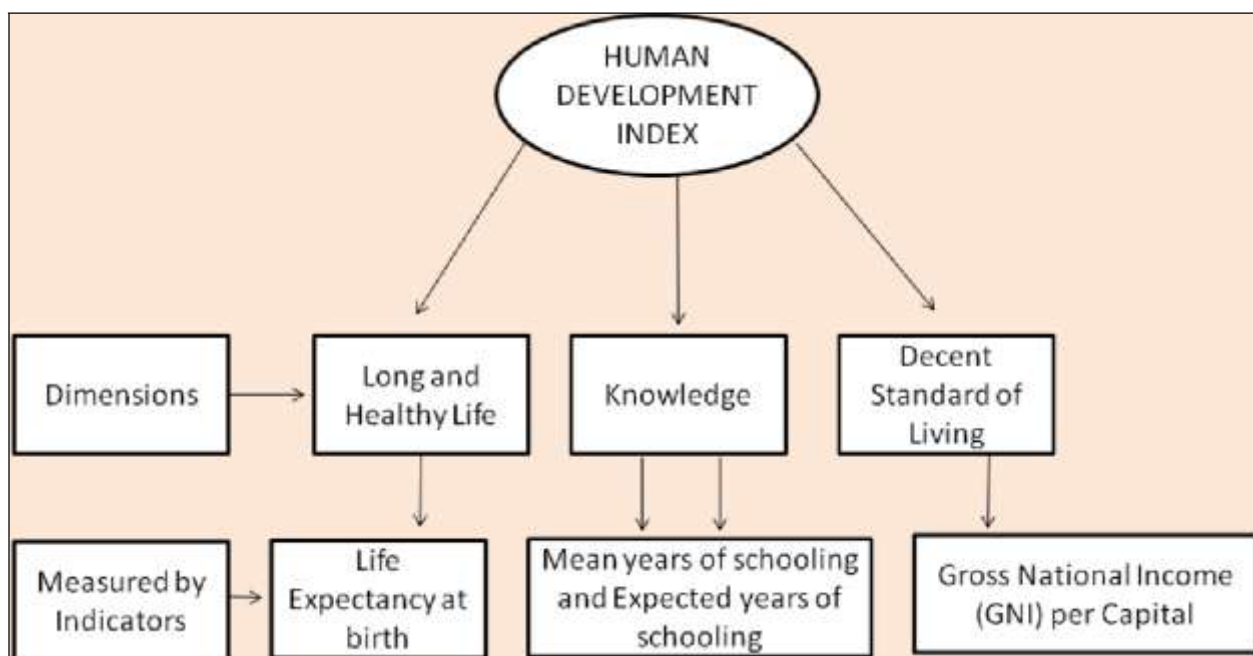


Figure 8: Components of human development index

The calculation of the human development index therefore combines four major indicators namely:

1. Life expectancy at birth: Number of years a new born infant could expect to live if prevailing pattern of age specific mortality rates at the time of birth stays the same throughout the infant's life.
2. Expected years of schooling for education:
3. Mean years for schooling for education: average number of years of education received by people age 25 and older, and
4. Gross National Income per Capita for Standard of living.

The HDI is a measure for assessing progress in human development based on a long and healthy life, access to knowledge and access to decent level of living. These indicators are then combined to generate an HDI score between zero and one. India's human development index (HDI) value of 0.624 puts it in the "Medium Human development" category. The world's top three countries in HDI are Norway (0.949), Australia (0.939) and Switzerland (0.939).

The next topic of interest is Sustainable Development Goals (SDG). These goals are an attempt to galvanize global effort towards social mobilization for a healthy community. Let's get to know them.

Sustainable Development Goals (SDG's)

Many of you may have heard or read about the Millennium Development Goals (MDG's) which were the anti-poverty initiative set up in 2000 by United Nation. Eight goals were set out in this Millennium declaration adopted globally which was largely successful but many shortfalls remained in this 15 year effort.

The SDG's replace the MDG's. In September 2015, the United Nation (UN) General Assembly adopted the 2030 agenda for Sustainable Development. This new agenda emphasized a holistic approach to achieve sustainable development for all which included 17 goals featuring 169 targets to be implemented from 2015 to 2030. These goals are adopted by member countries of UN, including India.

What are these 17 Goals?

Refer to Figure 9 which illustrates these 17 goals. Having read the Goals you would have realized that all SDG's are interconnected. They are a universal call to end poverty.



Figure 9: Sustainable development goals

But as a student of Nutrition, the goals and targets which should concern us the most include the following three as also highlighted in Box 2.

Goal 2: End hunger;

Goal 3: Good Health and well-being; and

Goal 6: Clean Water and Sanitation.

The target of reducing by 2030, all forms of malnutrition, including stunting and wasting in children under 5 years of age, is critical for India.

BOX 2: TARGETS FOR GOAL 2, 3 AND 6

Goal 2: End Hunger

Achieve food security and improved nutrition and promote sustainable agriculture

TARGETS

- ☐ By 2030, end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round.
- ☐ By 2030, end all forms of malnutrition, including achieving by 2025, the internationally agreed targets on stunting and wasting in children under 5 years of age, and address the nutritional needs of adolescent girls, pregnant and lactating and older persons.

Goal 3: Good Health and Well Being

Ensure healthy lives and promote well-being for all ages

TARGETS

- ☐ By 2030 reduce the global maternal mortality ratio to less than 70 per 100000 live births
- ☐ By 2030 end preventable death of newborns and children under 5 years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1000 live births and under-5 mortality to at least as low as 25 per 1000 live births
- ☐ By 2030, end the epidemic of AIDS, tuberculosis, malaria and combat hepatitis, water borne diseases and other communicable diseases
- ☐ By 2030, reduce by one third premature mortality from non -communicable diseases through prevention and treatment and promote mental health and well-being.

Goal 6: Clean Water and Sanitation

Ensure availability and sustainable management of water sanitation for all

TARGETS

- ☐ By 2030, achieve universal and equitable access to safe and affordable drinking water for all
- ☐ By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations

The SDG index ranks countries based on their performance across all these 17 sustainable development goals. India's overall performance and SDG trends (2018) are highlighted in Figure 10.

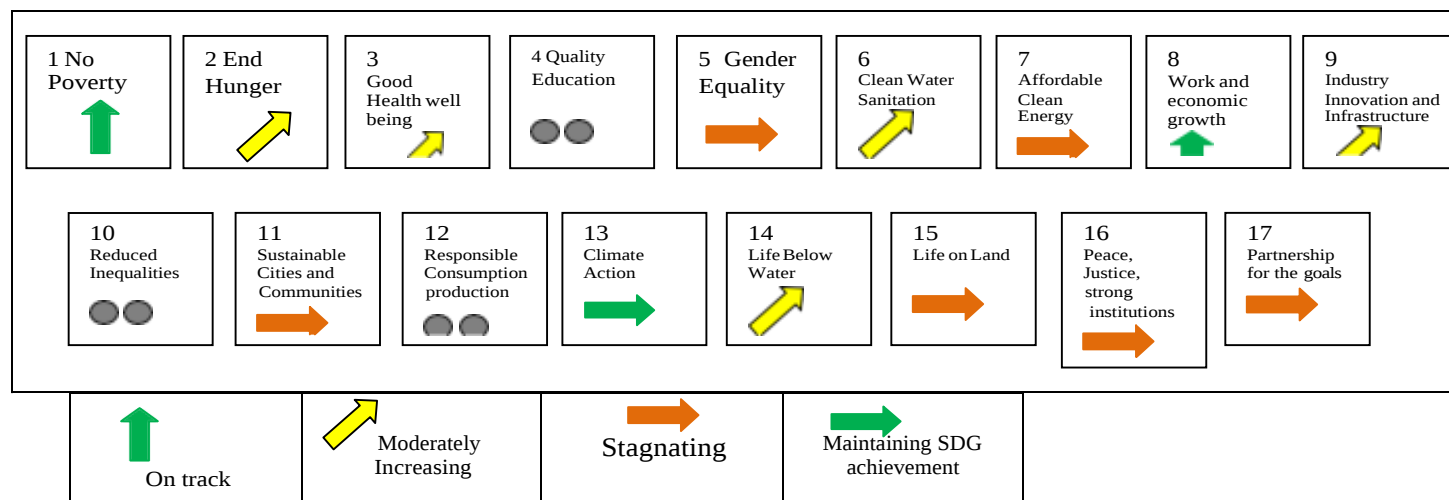


Figure 10: SDG trends in India

Source: SDG Index and Dashboard Report 2018

For Goals 2, 3 and 6 the trend depicted (refer to Figure 4) is a yellow moderately increasing line. This suggests that the score is increasing at a rate above 50% of the required growth rate but below the rate needed to achieve the SDG by 2030.

India is ranked 112 out of 156 nations on the SDG Index and Dashboard Report 2018.

To achieve these SDG's requires the partnership of Government, private sector, civil society and citizens alike to make sure we leave a better planet for our future generation.

UNIT I: RECOMMENDED DIETARY ALLOWANCES AND RDA OF INDIANS (ICMR 2010) AND THEIR USES IN PLANNING DIETS

Learning Objectives:

After reading this unit, the students will be able to:

- define the terminologies and concepts used in relation to human nutritional requirements,
- discuss the concept of recommended dietary allowance,
- state the significance and uses of recommended dietary allowances, and
- present the current nutrient recommendations for Indian population.

In a family there may be infants, young children, adolescent, adults, and elderly all living under one roof. It is always a big challenge to provide a good nutritious diet for each of the member, particularly when their needs, preferences vary. So what should be the guiding factor to ensure balanced meals that meet the needs of all members? Is there a Standard or a Reference that would serve as a goal for Good Nutrition? This section focuses on this important concept of Recommended Dietary Allowances.

RECOMMENDED DIETARY ALLOWANCES: BASIC CONCEPT

Humans need a wide range of nutrients to lead a healthy and active life. The amount of each nutrient needed for an individual depends on age, body weight, physical activity, physiological state (pregnancy, lactation) etc. So basically the requirement for nutrients varies from individual to individual. So, what do we mean by the term "*Nutrient Requirement*" here?

The requirement for a particular nutrient is the minimum amount that needs to be consumed to prevent symptoms of deficiency and to maintain satisfactory level of the nutrient in the body.

For example in case of infants and children, the requirement may be equated with the amount that will maintain a satisfactory rate of growth and development. Similarly for an adult the nutrient requirement is the amount that will maintain body weight and prevent the depletion of the nutrient from the body which otherwise may lead to deficiency. In physiological condition like pregnancy and lactation, adult women may need additional nutrients to meet the demand of fetal growth along with their own nutrient needs.

Now within each group (say infants or an adults etc) there may be individual variations in the nutrient requirements. For instance, there may be a period of low intake or the quality of the diet may

Bioavailability refers to the release of nutrient from the food, its absorption in the intestine and bio-response

vary, similarly the effect of cooking and processing may be different and bioavailability of the nutrient from the diet may also vary.

So how do we account for this? Well a *safety factor* is added over and above the nutrient requirement for each group to arrive at the Recommended Dietary Allowances.

$$\text{REQUIREMENT} + \text{SAFETY MARGIN} = \text{RECOMMENDED DIETARY INTAKE}$$

The Recommended Dietary Allowances (RDA) are the levels of intake of the essential nutrients that are judged to be adequate or sufficient to meet the nutrient requirement of nearly all (97 to 98 percent) healthy individuals in a particular life stage and gender group

From our discussion above it must be clear to you that the Nutrient Requirement of an individual and the Dietary Allowance for a group or a population are distinctly different. RDA takes into account the variability that exists in the requirement of a given nutrient between individuals in a given population group. So RDA is neither minimal requirement nor necessarily optimal level of intake. Rather, RDA is the *safe and adequate level*, which incorporates margin of safety intended to be sufficiently generous (high enough) to encompass the presumed variability in requirements among individuals and meet the needs of almost all healthy people.

Further please note, RDA's do not apply to people who are suffering from disease which influence the nutrient intake. They only apply to healthy people.

Next we shall review the significance, uses of RDA's.

SIGNIFICANCE/USES OF RDA

RDA, we know, represents the level of the nutrient to be consumed daily to meet all the requirements of most of the individuals in a given population. So RDA's help us plan balanced diets which include a variety of foods derived from diverse food groups which help meet the nutrient requirements. Other than this basic use, RDA's have come to serve many important purposes. The various applications of RDA include:

- Comparison of individual intakes to the RDA allows an estimate to be made about the probable risk of deficiency among individuals,
- Modifying nutrient requirements in clinical management of diseases,
- To help public health nutritionists to compose diets for schools, hospitals, prisons etc.
- For health care policy makers and public health nutritionists to design, develop nutrition intervention programmes and policies,
- For planning and procuring food supplies for population groups,
- For evaluating the adequacy of food supplies in meeting national nutritional needs,

- For interpreting food consumption records of individuals and populations,
- For establishing Standards for the national feeding programmes implemented by the Governments for its vulnerable population,
- For designing nutrition education programmes for the masses,
- For developing new food products and dietary supplements by the industry,
- Establishing guidelines for the national labeling of packaged foods (by Food Standards Safety Authority of India (FSSAI))

So that was a comprehensive list of uses of RDA. Next let us learn about the Recommended Dietary Allowances for Indians.

Recommended Dietary Allowances (RDA) for Indian Population

For the Indian population, the dietary standards have been computed by the Indian Council of Medical Research (ICMR). These recommendations have been published as "Nutrient Requirements and Recommended Dietary Allowances for Indians" (ICMR 2010)

The recommendations are constantly revised whenever new data is available. The last recommendations were revised in 2010, based on the new guidelines of the International Joint FAO/WHO/UNU Consultative Group and based on the data on Indians that had accumulated after 1989 recommendations. Table 1(a) and Table 1(b) present these recommendations. Study them carefully. To help you understand these recommendation here are a few highlights:

1. Note, the RDA for Indians are presented for the different age categories: 0-6 months, 7 to 12 months, 1 – 3 years, 4 – 6 years, 7 – 9 years, 10 – 12 years, 13 – 15 years, 16 – 18 years, adult man and women..
2. Recommendations are given for energy and all other nutrients including proteins, visible fat, calcium, iron, retinol, Beta Carotene, thiamine, riboflavin etc.
3. Recommended dietary allowances for adults are based on sex (male, female), body weight and physical activity level (i.e. Sedentary, Moderate and Heavy work) .
4. RDA for energy is expressed in kilocalories (Kcal), for proteins, fats in grams (g), and for calcium, iron, vitamins and minerals in milligram (mg) or microgram.
5. RDA for protein is based on body weight. The relationship can be expressed as 1g protein per kg body weight in the case of adults. It varies for other age categories.
6. RDA for energy and protein are given as additional intakes in pregnancy and lactation, indicated by a (" + " sign). This requirement is over and above the normal requirement of adult women. RDA for other nutrients are given as total intake figures.
7. In infancy RDA's for energy, protein, iron, thiamin, riboflavin and niacin are expressed as per kg body weight (expected for a healthy, normal growing infant of a particular age)
8. RDA for Vitamin A have been given in terms of retinol or alternatively in terms of Beta Carotene.

Summary of Recommended Dietary Allowances (RDA) for Energy, Protein, Fat and Minerals for Indians – 2010

Group	Category/Age	Body Weight (Kg)	Net Energy (Kcal/d)	Protein (g/d)	Visible Fat (g/d)	Calcium (mg/d)	Iron (mg/d)	Zinc (mg/d)	Magnesium (mg/d)
Men	Sedentary work	60	2320	60.0	25	600	17	12	340
	Moderate work		2730		30				
	Heavy work		3490		40				
Women	Sedentary work	55	1900	55	20	600	21	10	310
	Moderate work		2230		25				
	Heavy work		2850		30				
	Pregnant		+ 350		30				
	Lactating 0-6 m		+ 600		30				
Infants	6-12 m	5.4	+520	68	30	1200	21	12	30
	0-6 months		92 kcal/kg/d		1.16 g/kg/d				
	6-12 months		80 kcal/kg/d		1.69 g/kg/d		46 ug/kg/d	-	
Children	1-3 years	12.9	1060	16.7	17	600	09	5	50
	4-6 years	18.0	1350	20.1	25				
	7-9 years	25.1	1690	29.5	30				
Boys	10-12 years	34.3	2190	39.9	35	800	21	9	120
Girls	10-12 years	35.0	2010	40.4	35	800	27	9	160
Boys	13-15 years	47.6	2750	54.3	45	800	32	11	165
Girls	13-15 years	46.6	2330	51.9	40	800	27	11	210
Boys	16-17 years	55.4	3020	61.5	50	800	28	12	195
Girls	16-17 years	52.1	2440	55.5	35	800	26	12	235

Table 1(b) : Recommended Dietary Allowances for Indians (Vitamins)

Group	Category/Age	Body Weight (kg)	Vitamin A (µg/d)		Thiamine (mg/d)	Riboflavin (mg/d)	Niacin equivalent (mg/d)	Vitamin B ₆ (mg/d)	Ascorbic Acid (mg/d)	Dietary Folate (µg/d)	Vitamin B ₁₂ (µg/d)
			Retinal	Beta-carotene							
Men	Sedentary work	60	600	4800	1.2	1.4	16	2.0	40	200	1.0
	Moderate work				1.4	1.6	18				
	Heavy work				1.7	2.1	21				
Women	Sedentary work	55	600	4800	1.0	1.1	12	2.0	40	200	1.0
	Moderate work				1.1	1.3	14				
	Heavy work				1.4	1.7	16				
	Pregnant		800	6400	+0.2	+0.3	+2	2.5	60	500	1.2
	Lactating 0-6 months		950	7600	+0.3	+0.4	+4	2.5	80	300	1.5
	6-12 months				+0.2	+0.3	+3	2.5			
Infants	0-6 months	5.4	350	----	0.2	0.3	710 µg/kg	0.1	25	25	0.2
	6-12 months	8.4		2800	0.3	0.4	650 µg/kg	0.4			
Children	1-3 years	12.9	400	3200	0.5	0.6	8	0.9	40	80	0.2-1.0
	4-6 years	18.0			0.7	0.8	11	0.9		100	
	7-9 years	25.1	600	4800	0.8	1.0	13	1.6		120	
Boys	10-12 years	34.3	600	4800	1.1	1.3	15	1.6	40	140	0.2-1.0
Girls	10-12 years	35.0			1.0	1.2	13	1.6			
Boys	13-15 years	47.6			1.4	1.6	16	2.0	40	150	0.2-1.0
Girls	13-15 years	46.6			1.2	1.4	14	2.0			
Boys	16-17 years	55.4			1.5	1.8	17	2.0	40	200	0.2-1.0
Girls	16-17 years	52.1			1.0	1.2	14	2.0			

Source: Nutrient Requirements and Recommended Dietary Allowances for Indians (ICMR 2010)

Now that we have a fair good idea about recommended dietary allowances surely you should be able to recommend what individuals should eat and in what amounts to ensure a balanced diet. Off course knowledge of nutrients and the rich food sources of these nutrients will form the basis for diet planning. The amount of different foods to be consumed would depend on the RDA. Higher the RDA for a particular nutrient, the more should be the consumption of food rich in that nutrient. For example, we learnt that the RDA for energy for a heavy worker (adult male) is more as compared to a sedentary male adult. To meet these increased high needs of energy we must ensure that we include more of carbohydrates and fat rich foods in the diet of the heavy adult worker. Carbohydrate rich foods such as cereals, sugars, roots and tubers and fat from oils, butter, ghee etc. will help meet the increased energy requirement.

Similarly in case of infants (6-12 months of age) when the protein needs are high (1.69 g/kg body weight/d) as compared to adults (1g/kg body wt) it would be recommended that high protein rich foods such as milk and milk products, pulses, meat and meat products may be included in the diet of the infants. A detailed review on planning balanced diet is covered in another unit.

KNOWLEDGE ASSESSMENT - 1

Fill in the blanks

1. The RDA for energy is expressed as ----- .
2. During periods of physiological stress such as during pregnancy and lactation the requirement for energy and protein is given as ----- intake.
3. In infancy RDA for energy, protein etc is expressed as per kg ----- .
4. RDA for adults are based on sex, body weight and ----- .
5. Nutrient requirement is the ----- amount that needs to be consumed to prevent symptoms of deficiency and maintain satisfactory level of the nutrient in the body.
- 6.----- is added to the nutrient requirement to cover for variations in requirement from individual to individual
7. RDA's are basically ----- plus safety margin.
8. .RDA is the average daily nutrient intake sufficient to meet the nutrient requirement of nearly ----- percent of healthy individuals in a particular life stage and gender group.
9. In India the RDA's are provided by ----- .
10. RDA's apply only to ----- people and not to people suffering from ----- .

Answer: 1) Kilo Calories (Kcal); 2) additional; 3) body weight; 4) physical activity; 5) minimum; 6) Safety margin; 7) Nutrient requirement, 8) 97-98; 9) ICMR; 10) healthy, disease.

UNIT 6: NUTRITION EDUCATION, COMMUNICATION AND BEHAVIOUR CHANGE

Learning Objectives:

After reading this unit, the students will be able to:

- ☐ define the terminologies IEC, Behaviour Change Communication (BCC) and nutrition education (NE),
- ☐ explain the concept of BCC and its relation to IEC and nutrition education,
- ☐ discuss the need, scope and importance of behaviour change communication, and
- ☐ identify basic methods of communicating BCC centered messages to the target population

You may have seen health workers display posters, distribute pamphlets, screen films or make announcements or hold camps, specific to certain event, day or a cause. For example each year, June 21, is celebrated as World Yoga Day. Government and non government organizations pool their resources and organize yoga camps, and use the occasion to create awareness about yoga and its benefit for both physical and mental health. The purpose is to inform, educate and communicate (IEC) regarding the importance of the activity (i.e. promotion of good health, prevention of life style diseases like obesity, diabetes, heart diseases etc) but also as part of the effort to bring about a behaviour change i.e. promotion of positive behaviour in terms of including physical exercise as part of their daily routine. Similarly, you have also seen information, education and communication (IEC) being extensively used to improve immunization coverage in our country. The sustained IEC campaign on polio over several years has had a great unprecedented success as no case of polio has been reported since January 2011 thus paving the way for polio free India. World Health Organization (WHO) recognizes the important role of BCC in the achievement of health, nutrition and population goals. In this Unit we will focus on what is BCC, the process and the approaches to nutrition education communication. We begin with first defining the various terminologies used in the context of nutrition education communication.

TERMINOLOGIES USED IN THE CONTEXT OF NUTRITION EDUCATION COMMUNICATION

Education in nutrition is a necessary part of practical programmes to improve human nutrition. As a student of public nutrition you will come across terms like Behavior Change Communication (BCC), Information, Education and Communication (IEC) and very commonly nutrition education (NE) used

as an approach to create awareness and facilitate change in nutrition, health behaviour of individuals. What are these terms? Let's define them.

Nutrition Education (NE): Nutrition education is a process of persuading people to act in their own best interest for attaining nutritional well-being. It is a process by which beliefs, attitudes, environmental influences and understanding about food leads to practices that are sound, practical and consistent with individual needs that will make a maximum contribution to health and social well being.

Information, Education and Communication (IEC): IEC is described as a strategy to inform the public about nutrition/health concerns and attempts to change or reinforce a set of behaviour in a target population regarding the specific problem in a predefined period of time.

Behaviour Change Communication (BCC): BCC is a process of working with individuals, families, communities through different communication methods to promote positive health behaviour and support an environment that enables the community to maintain and sustain positive health behaviour.

Now that you have gone through the three definitions what do you notice? Yes, BCC, IEC and nutrition education terminologies, all three, are in fact, interchangeable. They all aim at creating awareness, motivating people to change behaviors and result in necessary action i.e. persuades people to adopt and sustain desirable nutrition and health practices. Disseminating knowledge provides important information; however, provision of information on its own has little effect. Action directed at strengthening the skills and capabilities of individuals to make healthy behaviour choices and change nutrition/health behaviour should be the objective of any nutrition education communication exercise. The biggest challenge in nutrition education communication is behaviour change. Behaviour change communication, therefore, is a process of promoting and sustaining healthy changes in behaviour in individuals and communities.

With this understanding let us learn about the need, scope of BCC.

NEED, SCOPE AND IMPORTANCE OF BEHAVIOUR CHANGE

COMMUNICATION (BCC)

BCC can play a vital role in improving the nutritional status of individuals, families and community members if they adopt positive nutrition behavior. BCC also has a vital role to play for policy makers as it helps mainstream nutrition into various projects and programmes. The following points highlight the importance of BCC and inform why it is essential:

- ☐ BCC helps individuals to make judicious food choices and select the best diet possible from the food available, whether it is home produced or must be purchased, often within limited funds. Further it suggests ways of improving the nutritive value of diet,
- ☐ It equips individuals to turn into better informed consumers by providing insight into the nutritional components of the food,
- ☐ It informs people about health, illness and therapeutic value of food and its role in the maintenance of health,
- ☐ It enables people to define their own problems and needs, understand what they can do about these problems and decide the most appropriate action and advocate for resources to promote health,
- ☐ It motivates people to develop favourable attitudes and change, adopt and maintain more healthful practices,
- ☐ It allows the individual to evaluate the nutrition information he/she has received and remove myths, misconceptions and taboos,
- ☐ It promotes and highlights the importance of sanitary food handling practices at home, the market, industry and institutions responsible for serving food to large number of people such as hostels, hospitals, schools, canteens and restaurants,
- ☐ It is an essential catalyst for nutrition impact in food security, community nutrition and health interventions,
- ☐ It promotes healthy lifelong eating and nutrition learning in schools, home and community,
- ☐ It equips policy makers and programme planners in formulating policies, developing supplementary feeding programmes for vulnerable sections of population, and
- ☐ It helps policy makers and planners to formulate policies for other sectors like agriculture, rural development, manufacturing industry etc. which are linked to food supplies thus directly effecting consumers.

With our study so far you have a good understanding of behavior change communication concept and the need and importance of BCC. You must have realized that BCC involves working with individuals, families, communities to develop communication strategies/ activities. The next section focuses on the process of behavior change communication.

BEHAVIOUR CHANGE COMMUNICATION PROCESS

Before we discuss the process of BCC let us first understand what is meant by the term 'communication'.

Communication simply defined, is the act of transmitting information, ideas and attitudes from one person to another such that intended goals are met. Communication is a two way

process wherein the message in the form of an idea, thought, feeling, opinion is transmitted between two or more persons with the intent of creating a shared understanding.

Figure 1 illustrates the communication process. If you look at the figure carefully you would identify four components in communication process. These include - SENDER, RECEIVER, MESSAGE and the FEEDBACK.

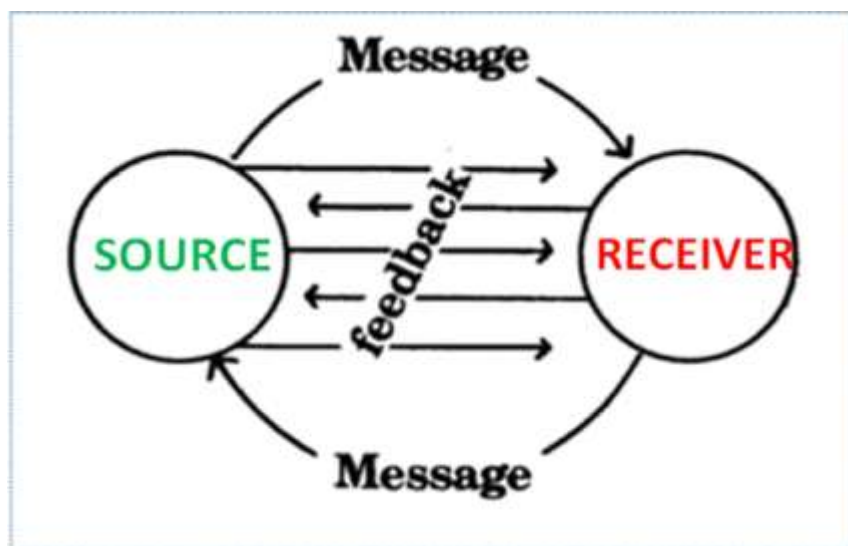


Figure 1: The communication process

Let us review these four components in the context of behaviour change communication:

1. The BCC process begins with the conceptualization of an idea by the SOURCE. In this process the sender or communicator communicates the message. The communicator can be any source, you or any other nutrition/health expert or health worker or it can be any medium/channel such as audio visual aid like the television, radio etc.

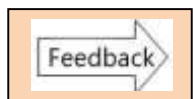


2. The second component is the Message. Message consists of what is actually communicated. Message can be oral, written, non verbal such as body gesture, sound etc. or picture or any other signal that we use to get our idea across for motivation or behavior change. An example of a written message in nutrition education communication could be: "Breast milk is the best food for the Infant". Remember, the message should be brief, logical, persuasive, coherent i.e. clearly address the problem/issue to be dealt with.



3. The third component is the RECEIVER. Receiver is the person/population (audience) for whom the message is intended or targeted. It can be an individual or a vulnerable group or a community as a whole with whom we communicate for change in behavior. For example in an infant and child feeding nutrition communication programme the primary audience could be the mothers, grandmothers or older siblings whoever is the caretakers of children, who need to be informed.





4. The last component is **FEEDBACK**. Feedback is defined as the response or information provided as a result of an event, the event in this case being the transmission of information. Feedback occurs when the receiver receives the message from a source. The receiver listens, reads or observes non verbal signals or visual information and send non verbal or verbal feedback to the source who can then modify the message in response to the feedback to make it more persuasive to the receiver. So you may have noticed that feedback is a two way process.

It would be worth remembering here that behavior change communication process will be effective only and only if all the four components highlighted above are present.

In order to facilitate the process of communication we need communication skills. These skills are gained through knowledge and practice of the methods of communication. The messages can be conveyed through a variety of communication methods. These are described in the next section.

BEHAVIOUR CHANGE COMMUNICATION METHODS

Information, education and communication (IEC) approaches are used to reach the target audience. There are a wide variety of methods/media that can be used to disseminate messages, information to the people. The correct choice of method is an essential aspect of communication in nutrition and health education. Off course which method to use will depend on who the target audience is i.e. are we reaching out to rural population or urban population or to school children or to general public? Each audience has their own characteristics (i.e. age, experiences, education level, exposure to media, reading, writing, listening skills, ownership of radio/TV etc.). Also the cost factor will influence the use of method/media.

Primarily the behaviour change communication methods can be categorized as:

- ☐ Interpersonal Communication methods: include all those forms of communication involving direct interaction between the source and the receiver. Examples of interpersonal communication methods include: interviews, individual discussions, face to face counseling or group discussions, community meetings, events etc.
- ☐ Mass communication media: Mass communication comprises techniques by which specialized groups employ technological devices such as press, radio, television audio visuals aids like films, documentaries etc. to disseminate content, information to large heterogeneous and widely dispersed audience, and

- Traditional Communication methods: the non electronic form of communication employing vocal, verbal, musical and visual folk art form, transmitted from an individual or a group of individual from one generation to another. Examples include folk music and dance, puppetry, storytelling etc. These are indigenous modes and have served the society as a medium of communication since ages. They were used for moral, religious, socio-political communication earlier but in the recent past, they are being used for educational purposes particularly in nutrition and health education.

Refer to Figure 2 which illustrates three different methods of communication.

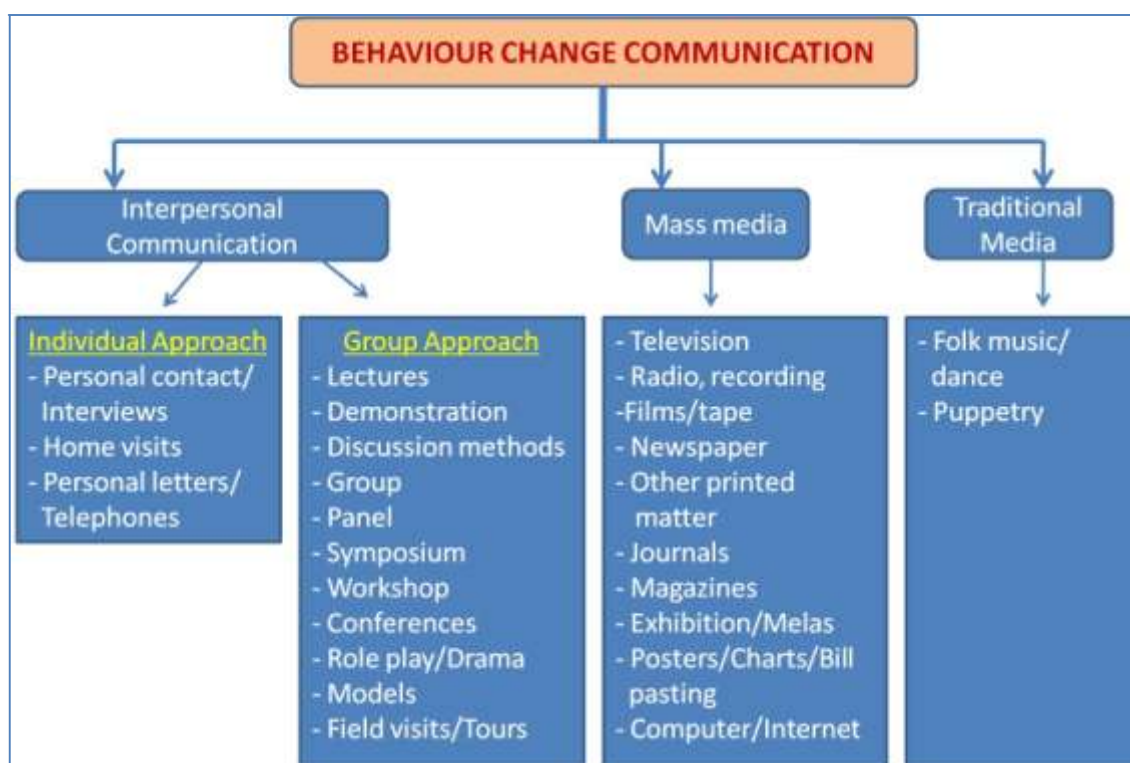


Figure 2: Behaviour change communication methods

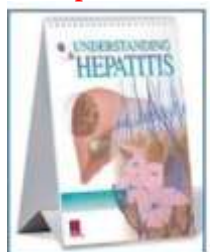
The most successful attempt to change nutrition/health habits have been based mainly on interpersonal communication used in conjunction with other methods. **Interpersonal communication** can take place as an individual approach or group approach. Under individual approach one-to-one counseling or home visit or one-to-one interview, telephone contact can take place. For example when a caregiver say a mother visits the hospital or a health facility, the nutrition health educator listens to the caregiver's problems and help her find solutions to her problems. Similarly, group discussion method involves face-to-face interaction with a group of people.

Lecture cum Discussion**Demonstration****Role Play**

Lectures, demonstrations, meetings, community events are all group discussion methods. Theories about behavior change emphasize that people develop confidence and are willing to perform a new behaviour when they can observe others in their community doing the same. Therefore, role play, drama can build people's confidence in performing a new practice.

The main advantage of using interpersonal communication method is that it is possible to contact specific individuals or groups of individuals and make the advice relevant to their social, health needs and develop problem solving skills and encourage community participation. But the method has few limitations as the approach can be slow for spreading information in a population as it would require travelling to different communities and need to mobilize large number of health/nutrition workers. Further in large groups it may be difficult to have feedback and discussions.

Mass media implies that we can reach large number of people at a time through the means of communications employed through this approach. In this method the Source and the Receiver are never in direct contact. The interaction between source and receiver is mediated through the visual image (poster, flip chart, video, TV etc.), print (news paper, magazines), verbal (radio, etc.) or by a combination of these elements. Mass media can be very effective in creating awareness and interest in new ideas among general population. It provides a rapid way to reach a large audience without using a lot of manpower. It makes good use of scarce resources. It not only informs but it also appropriate to create or reinforce change and motivates people. But the use of mass media can be limiting for large n diverse audience. The problems, needs may differ from one region to region or from people to people. Hence, it may be difficult to make the message appropriate to the special situation or need of the people. Mass media alone cannot persuade people to change deep-rooted attitudes or learn complex skills. We need to combine it with interpersonal communication also individual feedback is difficult to obtain.

Poster**Leaflet****Banner****TV Broadcast****Flip Chart****Newspaper**

Puppet



Folk Songs



Folktales



Traditional methods can be folk music, ballad forms of folk and puppetry. Some common forms of ballad style include Barrakatha (from Andhra Pradesh, Jugani and Vaar (Punjab). Adopting and composing folk songs, folktales and stories in local languages related to a particular problem can help people understand the issue. For example folktale relating to anaemia, can be designed on how misunderstanding the cause of anaemia led to the death of an anemic mother during child birth or the death of an anaemic child. Further, Puppetry too fascinates people of all ages, but children in particular. It can be effectively used to communicate nutrition/health messages in local languages to children.

Traditional media appeals at personal and intimate level. It can be available at very low cost. It is flexible in adopting themes specific to nutrition/health education. But traditional media is cultural specific and only people from a particular culture; region can identify the context and understand the message

From our discussion above we have a good idea about the different communication methods and their uses and limitations. So you can appreciate how methods can help change behavior. Remember, posters, charts, leaflets and other visual aids can provide information. Stories, dramas, plays can present role models for behavior change; discussions provide opportunities to provide for solving problems by two way interaction and feedbacks. Radio, TV and other audio video aids can remind people about action. So use the communication methods judiciously.

Also remember that the effectiveness of each method is specific to the audience or target group. For example, using mass media as a means to reach out to urban population is most effective. Similarly, while using interpersonal communication with rural women, demonstrations, charts, models may be more effective. It is always better to use a multi-media combination i.e. use several methods of communication in such a way that each one of them reinforces the other and their collective impact is greater than using a particular method alone.

We conclude our discussion here. Answer the education exercise given here to assess your understanding of the topic.

KNOWLEDGE ASSESSMENT - 1

Fill in the blanks

1. Behaviour change communication is a process of ----- and ----- healthy changes in behaviour.
2. BCC enables people to define their -----, understand what they can do about their problems and decide the most appropriate ----- to promote health.
3. The different behaviour communication methods include -----, ----- and -----.
4. The main advantage of face-to-face communication over mass media is that it creates opportunities for ----- and -----.
5. The advantage of mass media is that it makes good use of scarce -----.
6. Feedback should always be a ----- process.
7. The four components of communication process are -----, -----, ----- and -----.
8. Messages should be ----- and -----.
9. ----- is an example of individual approach and ----- is an example of group approach of interpersonal communication.
10. Puppets as a nutrition communication method will be most effective for use with -----.

Answer: 1) promoting, sustaining; 2) need, action; 3) interpersonal, mass media, traditional method; 4) feedback, discussions; 5) resources; 6) two-way; 7) source, receiver, message and feedback; 8) brief, persuasive; 9) One-to-one counseling/home visit, lecture/demonstration; 10) children.