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DIRECTORATE OF DISTANCE EDUCATION

M.Sc. (Home Science – Nutrition and Dietetics)

III - Semester

365 33

COMMUNITY NUTRITION

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INTRODUCTION

To introduce, the learners to the community nutrition will evoke interest in the subject and will make learning easier. Community Nutrition is a multifaceted subject involving nutrition, dietetics, food science, epidemiology and preventive and social medicine that plays a prime role in alleviating malnutrition (Over and under nutrition) for the upliftment of the individuals and society, as a whole. Community Nutrition encompasses a wide knowledge on nutritional diseases, consequences of diseases, which may be influenced by economy, environment and education.

This book on community nutrition is divided into four blocks and fourteen units, and includes all these criteria, their impacts on nutritional status and the means to root them out through remedial measures taken up by different Government and Non-Governmental Organisation at National and International levels. The objectives of providing an insight into the nutritional problems and their implications, to understand the international contribution towards nutritional improvements in India, and developing the skills in organising and evaluating nutrition projects in the community has been obliged. To serve the purpose of educating distance learning students, this book is presented in a comprehensible fashion and simple language. Every unit is detailed with the structure to prepare the student for what to expect in the text. Check Your Progress Questions in between the units helps the students to recollect what had been discussed and Self-Assessment Questions at the end of each unit aids the student to estimate the level of understanding on their own.

BLOCK-I: ASSESSMENT OF NUTRITIONAL STATUS AND MALNUTRITION

*Assessment Of
Nutritional Status*

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UNIT-1 ASSESSMENT OF NUTRITIONAL STATUS

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1.0 INTRODUCTION

The devising of any public health strategies to warfare malnutrition, in order to improve the nutritive eminence of a community, initiates with the evaluation of the nutritional status. The nutritional status assessment also assists in evaluating the type and extent of problems relating to nutrition, identifying the particular geographical boundaries and races affected, finding the underlying factors contributing to specific nutritional disorders. The complexity of the glitches concerning food and nutrition, among individuals and the community, should be understood to frame apposite measures and policies to eradicate these problems, for which the assessment of health status would pave the way.

1.1 OBJECTIVES

After, learning this unit, you will be able to:

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- Define nutritional status and assessment of nutritional status.
- Describe the need for assessment of nutritional status.
- Discuss the food and nutritional problems in the community settings.
- Explain the nutritional status of an individual.
- Outline the nutritional status of a community.

ASSESSMENT OF NUTRITIONAL STATUS

To assess the nutritional status, it is obligatory to understand the terminologies “Nutritional Status” and “Assessment of Nutritional Status” to go further with the chapter.

1.2.1 Nutritional Status

The term Nutritional status is defined as “The condition of health of an individual that is swayed by the consumption and utilization of nutrients”. The nutritional status of the community can be defined as “The presence or absence of diet-related diseases and its relation to the health and well-being of the community”.

Assessment of Nutritional Status can be put forth as “The interpretation of the nutritional status to determine whether an individual or a community is well nourished or malnourished”.

In other words, the modes of ascertaining the nutritional status of an individual or community is known as assessment of nutritional status.

British Dietetic Association defines Nutritional assessment as the systematic process of collecting and interpreting information in order to make decisions about the nature and cause of nutrition related health issues that affect an individual or the community.

Well-nourished or normal nutritional status means that there is an optimal intake of balanced foods and the nutrients are properly utilised, wherein malnutrition refers to improper food intake or inadequate nutrient utilization. Both over nutrition and under nutrition are categorised as malnutrition.

The methods of assessing nutritional status are classified into direct and indirect methods. The direct methods being Anthropometry, Biochemical, Biophysical, Clinical examination, Dietary survey and Functional assessment, while vital statistics and ecological factors assessment are indirect methods of nutritional assessment which will be discussed in detail in UNIT-2.

Now, we shall study the need for assessment of nutritional status.

1.2.2 Need for Assessment of Nutritional Status

The need and importance to assess the nutritional status can be listed as:

- To discover facts and guiding actions intended to improve nutrition and health.

- To measure the magnitude and epidemiology of malnutrition.
- To identify the type of malnutrition.
- To determine the demographic groups at risk of becoming malnourished.
- To find and analyse the causative ecological factors that contribute to malnutrition either directly or indirectly.
- To advocate appropriate remedial actions or to tailor apt health care surveillance programmes.
- To provide empirical evidence for the pervasiveness of malnutrition to concerned personnel or policy makers to make them comprehend the extent of the problem.
- To govern the impact of existing nutritional programmes or policies.
- To minimize the medical expenses and to improve the economic productivity of the individual and the nation, as well.

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Check Your Progress

1. Define Nutritional Status.
2. What is nutritional assessment?
3. Enlist the need for assessment of nutritional status.

1.3 FOOD AND NUTRITIONAL PROBLEMS IN THE COMMUNITY

A community may be any group of individuals, for example, the population of a town or country, or the residents of an old people's home. The Community Nutrition aims at improving the quality of life and to augment to health promotion of the population in the community where programs and services are outlined to deliver adequate food consumption patterns and promote healthy lifestyles. Community nutrition includes nutritional surveillance, epidemiological studies of diet and also the development, implementation, and evaluation of dietary recommendations and goals.

1.3.1 Food Security and Food Insecurity

Food security is an important criteria to be considered while discussing the problems of food and nutrition in the community.

World Food Summit, 1996 has demarcated food security as "When all people at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their daily needs and food preferences for an active and healthy life".

Food security plays an utmost role in improving the nutritional status of the community, by guaranteeing food to all those who suffer from continuous hunger and under-nutrition and for the at-risk groups. In simple terms food

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security means access to the food by all people at all times to lead a dynamic and vigorous life.

The National Food Security Act, 2013 provides for food and nutritional security at affordable prices and enables people to live a life with dignity.

Food security has interrelated dimensions namely - availability, accessibility, utilization, stability and vulnerability.

- **Availability of food** relates to food production within the country, food imports and food stock available in government granaries.
- **Accessibility to food** means that food is within the reach of every person. Food accessibility is linked to affordability, which implies that an individual is bestowed with enough money to buy sufficient safe and nutritious food to meet one's dietary needs. This is also depends on the resources like labour and knowledge along with the purchasing power.
- **Food Utilization** refers to proper use of food, water and openness to adequate sanitation. Eating preferences, food cultures and taboos, nutritional awareness at individual and community level influence effective food utilization.
- **Food Stability** Extremities of weather, economic fluctuations, civil conflicts will impact the stability of food supply which in turn affects the other determinants also as they are interlinked.
- **Food Vulnerability** is the parameter that relates to the persons or health conditions at-risk. This group demand a high requirement of food and assuring food security is a must to avoid fatal conditions.

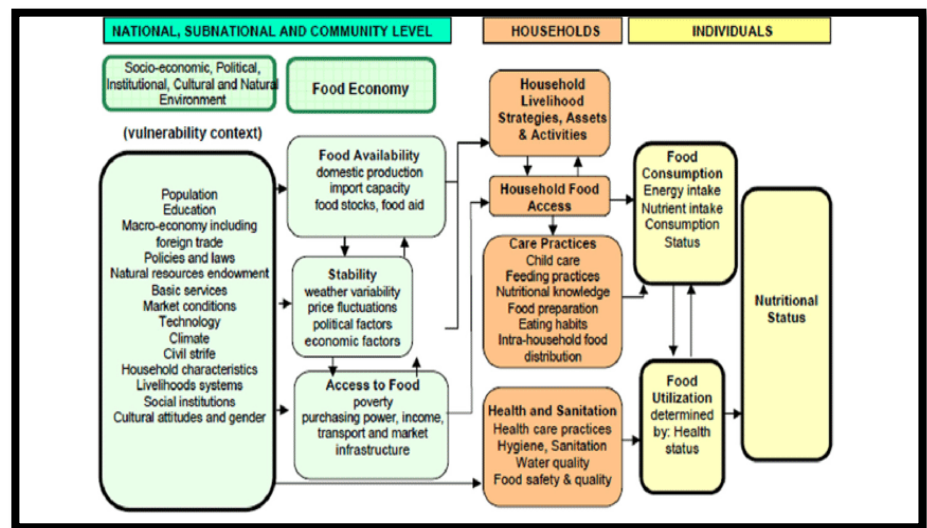


Figure 1.1 FAO/FIVIMS Framework: Linkages between the Overall Development Context, the Food Economy, Households and Individual Measures of Wellbeing

Source: FAO FIVIMS 2010

This frame work clearly depicts the components related to food security and food insecurity. Moreover, it is also noteworthy to understand that utilization of food translates food security to nutrition security. The

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nutrition security is defined as a “Balance between biological requirement in energy and nutrients and the quantity and quality of foods consumed”. According to Food and Agriculture Organisation Nutrition Security is “Physical, economic, environmental and social access to balanced diet and clean drinking water for every child, woman and man”. The physical, economic, social and environmental determinants which have an impact on the food and nutritional security being,

- Lack of nutritional knowledge and awareness
- Gender inequality
- Denial to safe water
- Inadequate sanitary environment
- Natural calamities
- Urbanisation
- Low per capita income
- Low Wages
- Unemployment and underemployment
- Inequalities in land distribution
- Low land utilization
- Agricultural instabilities
- Population growth
- Poverty
- Political instability
- Social discrimination

In spite of all these hurdles, it is imperative to sustain household food security, for improving nutritional status of the community. The lacunae in any of the determinants lead to food insecurity. Deficits in food production or in food availability through import/ export lead to food insecurity due to rise in prices or breakdown in distribution channels. At the household level, inadequate access to food is primarily due to poverty, poor households do not have sufficient means to secure the food they need leading to food insecurity.

Food insecurity leads to much social anguish. Also, it results in considerable productivity losses to the individual and community due to reduced work performance, lower cognitive ability and school performance and reduced income earnings, stress and chronic disease conditions arising out of inadequate food and nutritional deficiencies. Food security and adequate nutrition are beneficial outcomes in themselves as well as important inputs to economic development.

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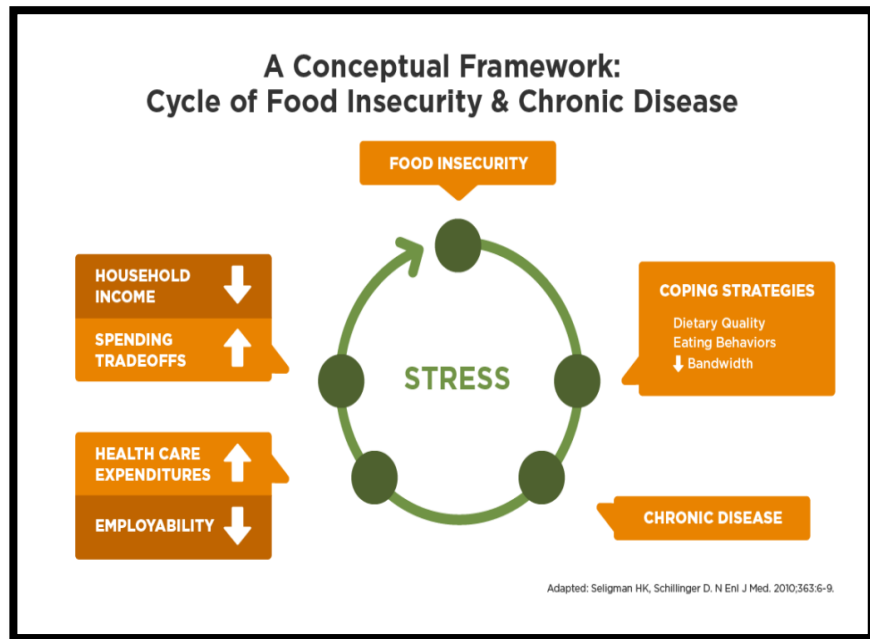


Figure: 1.2

Source: Seligman and Schlinger New England Jnl. of Medicine, 2010

Food insecurity can be either chronic or transitory. Chronic food insecurity describes a situation in which households constantly lack adequate access to food. Transitory food insecurity is a condition in which households do not have access to food at certain times; it arises from failure of livestock and crop production, loss of employment, import difficulties, man-made and natural disasters and other adverse circumstances.

1.3.2 Initiatives to Improve Food Security

National, regional and local availability of food depends primarily on production, stockholding and imports and exports of food materials. To overcome any kind of food insecurity, the Indian Government has built buffer stocks, set up Public distribution systems (PDS), in which the food procured by Food Corporation of India is distributed through government regulated ration shops among poorer section of the society either at free of cost or at a price very much lower than the market price. Thereby, making sure that the food is secured to all at all levels to maintain the nutritional status of a community through effective food distribution strategies.

Also, an effective food control system improves the nutritional status of the population through manifolds viz:

- Ensuring that nutrient composition of foods is retained during the food chain i.e. production, storage, handling, processing, packaging, and preparation;
- Preventing and controlling biological and chemical contamination of foods;

- Promoting hygienic practices throughout the food industry by establishing appropriate codes and standards and training of food handling personnel;
- Reducing food losses caused by spoilage, contamination or improper storage or distribution;
- Promoting a safe and honestly presented food supply by requiring composition and nutrient information on food labels; and
- Educating consumers about foods that are injurious to health, or unfit for human consumption, or are nutritionally or economically degraded.

Apart from improving the nutritional status, an effective food control system encourages the orderly development of a nation's food industries, creates greater outlets for the farmers produce, stimulates increased foreign exchange earnings through export of foods that comply with acceptable standards, and avoids losses that occur when substandard foods are traded. All these effects help to create jobs, increase incomes, and ultimately improve nutritional status as consumers' diets become more varied and nutritious.

As a result, strengthening food control systems and creating awareness to the consumers about food handling practices and proper food choices are essential to warrant proper nutrition in the community.

Check Your Progress

4. Define Food Security.
5. Discuss the dimensions of food security.
6. Explain the ways to improve food security.

1.4 NUTRITIONAL STATUS OF AN INDIVIDUAL AND COMMUNITY

The definition of nutritional status has been discussed already under 1.3.1.

As defined by WHO, Health is the "State of complete physical, mental and social well-being and not merely the absence of disease and infirmity". Optimal health and balanced nutrition is the right of every individual. The goal of optimal nutritional status, can be reached by consuming a balanced diet, where the normal physical and mental development is achieved. Good nutritional status is also reflected by stamina, resistance to diseases, ideal body weight and also good sleep. It is also being emphasised by nutritionist that the health status of an individual should progress to holistic health from optimal health. "**Bionutrition**" intends to assure holistic health by encompassing all the health contingencies and then building up organically the inner reserves to combat

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chronic diseases. Bionutrition shoulders to provide preventive and curative treatment by consuming adequate nutrients in adequate proportions.

Malnutrition arises as a result of deficiency or excess of one or more essential nutrients. It is a broad term which includes both under nutrition and over nutrition, imbalance and specific deficiency states.

Under nutrition can be stated as the condition caused by eating too little or an unbalanced diet that does not contain all nutrients necessary for good nutritional status. Under nutrition is primarily due to inadequate energy, protein and micronutrients to meet basic requirements for body maintenance, growth and development and in some instances may also be due to defective metabolism leading to improper absorption and utilisation of nutrients.

The effects of under nutrition are stunting, high morbidity and mortality among young children, retarded physical growth, and poor cognitive development, lowered vitality leading to lowered productivity and reduced life expectancy. The high rate of maternal mortality, still births and low birth weight are also associated with under nutrition.

In contrary, **over nutrition** can be defined as a condition in which an individual consumes excess of nutrients than prescribed in the RDA. The health hazards from over nutrition are high incidence of metabolic disorders and non-communicable diseases such as obesity, diabetes mellitus, hypertension, cardiovascular diseases, renal diseases, and hepatic and gastro intestinal disorders.

Imbalance is the pathological state caused due to disproportion among essential nutrients, either with or without absolute lack of any nutrient.

Specific Deficiency is caused due to relative or absolute deficiency of an individual nutrient.

Table 1.1: Malnutrition – Causes and Factors

Causes of malnutrition	Factors Influencing malnutrition
Decreased availability of food due to <ul style="list-style-type: none">• Increase in demand due to population increase• Low production• Exhaustion of stocks	Lowered food intake
Ignorance	Wrong infant feeding practices, inability to make correct choice of food resulting in over/under nutrition
Economic conditions	Lowered purchasing power

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	causing under nutrition/higher purchasing power causing over nutrition
Vulnerable groups	Inability to meet the increased nutrient needs during periods of rapid physical growth, e.g. in young children, adolescents, pregnant woman and lactating mothers; Nutrient demands also increases during illnesses.
Poor personal hygiene and environmental sanitation	Increased susceptibility to infections and thereby illnesses

1.4.1 Community Health and Factors Affecting Community Health

A wide range of primitive, preventive and curative health care services required and provided at individual and community level is an important aspect of consideration to preserve a nation's health and economy.

The important dynamics that determine the community nutritional status are:

- **Geographical and Physical Conditions:** The availability of natural resources, type of land, temperature, rainfall, transport accessibility, industries located will have a greater influence on the nutritional status of the community.
- **Agricultural Practices:** The types and quantity of crops cultivated, nutritional parameters of the produce, post-harvest practices will affect the community health.
- **Demographical Framework:** It is well understood and established that the status of every individual reflects the community. The population characteristics like family size, type of family, sex ratio, ratio of young to geriatric population, urban and rural population index reflects on the nutritional status of the community.
- **Cultural Practices:** The practices of maternal and child health, attitude towards family planning, towards diseases and treatment practices echoes on the community health status.
- **Socio Economic Background:** Family income, owning a land, animal husbandry, and local resources and women literacy dispenses a significant bearing on community health.
- **Health Strings:** Morbidity and mortality rates with age and cause, accessibility to healthcare centres, Governments and non-Governmental organisations initiatives to promote health, medical advancements, availability of medico and paramedical manpower, Hygiene and environmental sanitation, spacing of pregnancies are all contributory factors to evaluate the nutritional status of a community.

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- **Dietary Practices:** Breast feeding and weaning practices, cooking and nutritional knowledge also affect the nutritional status of a community.

1.4.2 Facts to be Considered to Enhance the Nutritional Status

To enhance the nutritional status on the whole,

- Nutrition education must be initiated in schools and in the community settings.
- Development and reinforcement of science based food preparation skills across all age groups.
- Promoting sanitary environment practices.
- Individual dietary counselling will become a key strategy.
- Community nutrition practitioners must create awareness on healthy and physically active life style.

1.4.3 Food Habits and Nutritional Status

Food plays a great role in human survival and also social portrayal. There are various aspects which regulate the food choices and attitude towards food which can be named as Food Related Behaviour or Food Habits. The factors which affect food behaviour are :

- **Physical Factors:** The physical factors namely access to food, education and knowledge on nutrition, cooking skills and time available to cook and dine determine the food habits and in turn the nutritional status.
- **Psychological Factors:** Emotions plays a vital role in determining food behaviour. Positive emotions like happiness induce hunger and increase the intake of food, while negative emotions like stress have complex influence, where some people eat more and some eat less. These psychological factors and eating disorders take up a vital role in ascertaining the food intake and nutritional status.
- **Biological Factors:** Hunger, appetite which affects appearance, flavour, taste and palatability affecting the sensory organs directly influence the attitude towards food available. Highly palatable food provided every day, improves food take and creates a healthy community and vice versa.
- **Social Factors:** Peer effect, cultural influence, family taboos are considered as important social elements which affect food choices and in turn nutritional status. For example male members in the family are prioritized while serving food and only the left overs are shared by female members which results in poor nutritional status of women.
- **Economic Factors:** Affordability to nutritious food is determined by income and expenses incurred towards food. Non- vegetarian foods, pulses, fruits are considered to be expensive and hence avoided by people of low income group, which may lead to malnutrition.

Check Your Progress

7. Define Bionutrition.

8. How to enhance the nutritional status of a community?

1.5 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

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1. The presence or absence of diet-related diseases and its relation to the health and well-being of the community.
2. British Dietetic Association defines Nutritional assessment as the systematic process of collecting and interpreting information in order to make decisions about the nature and cause of nutrition related health issues that affect an individual or the community.
3. To discover facts and guiding actions intended to improve nutrition and health, measure the magnitude and epidemiology of malnutrition, determine the demographic groups at risk of becoming malnourished, find and analyse the causative ecological factors that contribute to malnutrition either directly or indirectly, advocate appropriate remedial actions or to tailor apt health care surveillance programmes, provide empirical evidence for the pervasiveness of malnutrition to concerned personnel or policy makers to make them comprehend the extent of the problem, govern the impact of existing nutritional programmes or policies, minimize the medical expenses and to improve the economic productivity of the individual and the nation, as well.
4. Food security means access to the food by all people at all times to lead an active and healthy life.
5. Food security has four dimensions namely - availability, accessibility, utilization and vulnerability.
6. Ensuring that nutrient composition of foods is retained during the food chain, Preventing and controlling biological and chemical contamination of foods, Promoting hygienic practices throughout the food industry by establishing appropriate codes and standards and training of food handling personnel, Reducing food losses caused by spoilage, contamination or improper storage or distribution, Promoting a safe and honestly presented food supply by requiring composition and nutrient information on food labels; and Educating consumers about foods that are injurious to health, or unfit for human consumption, or are nutritionally or economically degraded.
7. Bionutrition intends to assure holistic health by encompassing all the health contingencies and then building up organically the inner reserves to combat chronic diseases. Bionutrition shoulders to provide preventive and curative treatment by consuming adequate nutrients in adequate proportions.
8. Nutrition education must be initiated in schools and in the community settings, Development and reinforcement of science

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based food preparation skills across all age groups, Promoting sanitary environment practices, individual dietary counselling will become a key strategy, Community nutrition practitioners must create awareness on healthy and physically active life style.

1.6 SUMMARY

This unit provides us an understanding of the nutritional status, why is the assessment of nutritional status an important determinant of country's prosperity, the food and nutritional problems existing in a community and the Governments initiatives to overcome malnutrition through ensuring food security. We have also discussed the determinants of food security and the various initiatives to be taken to improve food security. This unit has clearly picturized the terms related to nutrition and nutritional status, causes of food malnutrition, and role of food habits in determining the nutritional status.

1.7 KEY WORDS

- **Nutritional Status:** The condition of health of an individual that is swayed by the consumption and utilization of nutrients.
- **Nutrition Security:** Physical, economic, environmental and social access to balanced diet and clean drinking water for every child, woman and man.

1.8 SELF ASSESSMENT QUESTIONS AND ANSWERS

Short Answer Questions

1. Write a short note on under nutrition.
2. Define malnutrition. Explain the causes and factors influencing malnutrition.
3. Describe the link between the food habits and nutritional status.
4. Explain the chain of food insecurity and chronic diseases.

Long Answer Questions

1. What is community health? Discuss the factors contributing to community health.
2. Correlate the role of various dynamics involved in achieving nutrition security.

1.9 FURTHER READINGS

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UNIT-2 DIRECT AND INDIRECT METHODS OF NUTRITIONAL ASSESSMENT

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Structure

- 2.0 Introduction
- 2.1 Objectives
- 2.2 Methods of Assessment of Nutritional Status
 - 2.2.1 Direct Assessment Methods
 - 2.2.1.1 Anthropometry
 - 2.2.1.2 Biochemical
 - 2.2.1.3 Biophysical
 - 2.2.1.4 Clinical
 - 2.2.1.5 Dietary Assessment
 - 2.2.1.6 Functional Assessment
 - 2.2.2 Indirect Assessment Methods
 - 2.2.2.1 Vital Health statistics
 - 2.2.2.2 Ecological Factors Assessment
- 2.3 Answers to check your Progress Questions
- 2.4 Summary
- 2.5 Key Words
- 2.6 Self-Assessment Questions and Answers
- 2.7 Further Readings

2.0 INTRODUCTION

In our earlier unit we have studied the importance of assessing the nutritional status of an individual and the community and how it will help in the growth and development of a nation.

In this unit we shall learn about the different methods of assessing the nutritional status. As we all know that to combat malnutrition the first step to be formulated is assessment of nutritional status. Hence, it is understood that the methods of assessment, in particular are important to get started with the process.

2.1 OBJECTIVES

After studying this unit, you will be able to

- Describe the different methods of nutritional assessment.
- Explain the significance of different methods.
- List the advantages and disadvantages of the methods.

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- Relate the relevance of the types of assessment to various age groups.

2.2 METHODS OF NUTRITIONAL ASSESSMENT

As students of Nutrition it is important for us to know how the disease progress. As well established the known primary cause of any nutritional deficiency is inadequate supply of nutrients as the cause may be either poverty, non-availability of foods or lack of nutritional knowledge as the case may be as we have discussed under food insecurity in previous unit.

This dietary inadequacy leads to changes in muscle mass, muscle wasting and progressing to anatomical changes in some organs of the body which can be determined by naked eye by a well experienced nutritionist or dietician by clinical examination. If the inadequacies continue further changes which are termed as subclinical changes, can be recognized by biochemical, biophysical or functional assessment. The severity of nutritional deficiency identified by these direct examinations help to retrieve the nutritional status of the community by helping the Government make policy decisions and take immediate measures.

Before stepping into the methods of assessment, let us review the sequence of development of nutritional deficiency that starts from dietary inadequacy to when the signs and symptoms of nutrition deficit becomes evident. A clear understanding of the stages of deficiency is crucial in order to select the techniques needed to assess the nutritional status. It is important to keep in mind that in practice, the relative availability of some nutrients to support biochemical functions varies from day to day with fluctuations in intake. Hence, flow in table 2.1 may be upward or downward and a single biochemical index or clinical observation will not reveal the direction of events. Furthermore, the rapidity with which the direction of flow responds to alterations in food or nutrient supply will vary. For example, anatomical signs, though the last to appear, may take substantially longer to disappear than will restoration of the activity of nutrient-dependent enzymes or the concentration of the nutrient in blood. Accordingly, it is not mandatory that the biochemical assessment of nutritional status for an explicit nutrient should always directly correlate with the findings from dietary survey or clinical assessment, particularly when applied on an individual or among subjects of small sample size. Generally, when applied to a community for assessment of nutritional stature, the trend will be in the same direction for dietary, biochemical, and clinical findings.

To use cross-sectionally obtained measurements for purposes of evaluating the nutritional impact of nutrition interventions, a laboratory measurement should be chosen that represents the cumulative effects on nutrition, rather than immediate responses to dietary intake. On the other hand, acute changes in the physiological environment, acute infection,

hormonal balances etc., as well as diet, can shift the dissemination of nutrients among sections, thus affecting biochemical events. Therefore it is often also useful to have an indicator of the immediate situation, particularly when dealing with individuals or populations of small size. In all cases, an appropriate comparison group is necessary to evaluate associations among laboratory measurements with nutritional intervention.

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Table 2.1: Scheme of the Development of Nutritional Deficiency and Specificity of Methods of assessment.

Nutrient Depletion Sequence	Assessment Methods
Dietary inadequacy ↓	Dietary assessment
Tissue reserve store decreases ↓ Body fluid level decreases ↓ Decrease in nutrient dependent enzymes ↓	Biochemical estimation
Functional performance decrease ↓	Biophysical , functional
Change in Clinical signs and symptoms ↓	Clinical examination
Anatomical Sign ↓	Anthropometry
Morbidity, Mortality	Vital health statistics

The methods of nutritional assessment are categorised into Direct and Indirect methods. The following table will help you to understand the methods available under direct assessment and indirect assessment as well.

Table 2.2: Methods of Nutritional Assessment

Direct Methods	Indirect Methods
Anthropometry Biochemical and Laboratory estimation Biophysical or radiological examination Clinical examination Dietary survey Functional assessment	Vital health statistics Ecological factors assessment

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2.2.1 Direct Assessment Methods

Let us first discuss about the direct methods of nutritional assessment.

Direct assessment as the name implies the nutritional status of the community can be assessed by reaching the sample population directly and is considered as the more appropriate method of assessment. The Anthropometry, Biochemical/ Biophysical, Clinical, Diet survey, Functional assessment abbreviated as ABCDF are the direct assessment methods.

We shall now discuss each of the direct methods in detail.

2.2.1.1 Anthropometry

Human body reflects changes in morphological variation due to inappropriate food intake or malnutrition. Information on this aspect is therefore important and has practical application.

The word anthropometry comes from two words: Anthro means 'human' and metry means 'measurement'. Nutritional anthropometry is the tool concerned with the measurement of the physical dimensions, the gross composition of the human body at various ages and degrees of nutritional status. Due to the simplicity and as it needs least sophisticated instruments the anthropometry forms an important and integral part of any nutrition survey.

Application of Anthropometry

- Anthropometric measurements are reliable tools for assessment of subclinical forms of malnutrition.
- To assess the extent of malnutrition in vulnerable groups.
- To identify at-risk groups at earlier stages and prioritize the nutrition action programmes to the needy.
- To evaluate the outcome of objectives of the intervention programmes.
- To monitor the individual's response to nutritional rehabilitation measures.
- To appraise the impact of seasonal variation of food supplies on nutritional status of the community.
- This can be used as a tool for nutritional surveillance and for collection of secondary data on indicators which may directly or indirectly affect the nutritional status.

Having gone through the above points you would now realize the importance of nutritional anthropometric measurements. Now let us study the common anthropometric measurements used in determining nutritional status.

Common Anthropometric Measurements

Though there are number of tools and techniques are available

under anthropometry the simplest, quickest and easiest to reproduce will give maximum information concerning the nutritional problem to be identified. The most commonly used anthropometric measurements include:

- Body mass as judged by body weight,
- Linear dimension such as height,
- Reserves of energy, protein and fat by superficial soft tissues,
- Muscle development by Mid-Upper Arm Circumference (MUAC), and many more.

So, we shall try to understand the relevance of the body measurements and the methods of their measurement in the following sections.

Body weight is the first method that shall be discussed now.

1. Body Weight

Body weight is considered as an important and foremost simplest reproducible anthropometric measurement for overall status of individuals, especially children.

Significance of body weight

- Body weight indicates the body mass and is a composite of all body constituents like water, mineral, fat, protein and bone.
- It reflects more recent nutrition than the height.
- Serial measurements of weight as in growth monitoring are more sensitive indicators of changes in nutritional status than a single measurement at a point of time.
- Rapid loss of body weight in children should be considered as an indicator of potential malnutrition.

Equipments and Techniques of Body Weight Measurement

The accuracy of body weight depends on the choice of suitable weighing scale. For measuring body weight **beam or lever actuated scales**, with an accuracy of 50-100g are preferred. Beam balances are extensively used in ICDS projects.

Salter Weighing Scale is light and portable can be hung from a roof or tree, placing the child in the sling and then the weight is recorded by the measurer.

The **spring balance** used in the bathroom type weighing scales, are not recommended as the springs easily stretch and inaccurate when used frequently.

Periodically scales need to be calibrated for accuracy using known weights. Weights should be taken with the individual under basal conditions with minimum clothing and without shoes. The zero error of

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the weighing scale should be checked before taking the weight and corrected as and when required.

The mean of three successive measurements will give the final body weight of the subject.

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***Figure 2.1: Weighing a Child Using Beam or Lever Scales
Source: Detecto Mechanical Weigh Beam Pediatric Medical
Scale***



Figure 2.2: Weighing a Child Using Salter Scales

Now, having understood the techniques of weight measurement, we will study about the second important parameter, height, which is used in

nutritional anthropometry.

2. Height

Hereditary and environmental factors have a great influence in determining the height of an individual. The maximum growth potential of an individual is decided by hereditary factors, while the environmental factors the most important being nutrition and morbidity, determine the extent of exploitation of that genetic potential. Height is affected only by long-term nutritional deprivation, it is considered an index of chronic or long duration malnutrition.

Equipments and Techniques of Height Measurement

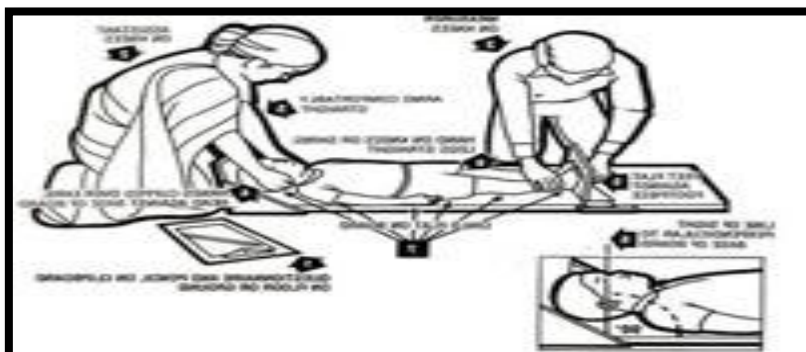
Infantometer is used to measure the recumbent length or crown-heel length in children below the age of two years who cannot stand properly.

The infant is laid on the flat surface of the board, with the head positioned firmly against the head board with eyes looking vertically. The legs need to be held straight and firm with the feet touching the sliding board. The upright sliding foot piece is moved to obtain firm contact with heels and the length reads to the nearest 0.1cm.

Anthropometer or stadiometer with a vertical measuring rod is used to measure the height of order children and adults. The subject should stand erect looking straight on a levelled surface with feet together and toes apart, and with the heels, buttock and shoulder and back of the head touching the upright. The moving head pieces of the anthropometer should be lowered to rest flat on the top of the head and the reading should be taken. Height should be read to the nearest 1/4" or 0.5cm.

In case of **Non-ambulatory** person, the height is measured by asking the person to raise the heads sidewise which will give the height of the person. This measurement is known as **Demi-span**. Also knee height and ulna length can be used to assess the height of the non-ambulatory persons and these measurements are known as surrogate measure of height.

An average of three measurements is taken as the final measurement.



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Figure 2.3: Length Measurement of an infant by Infantometer (UN 1986)

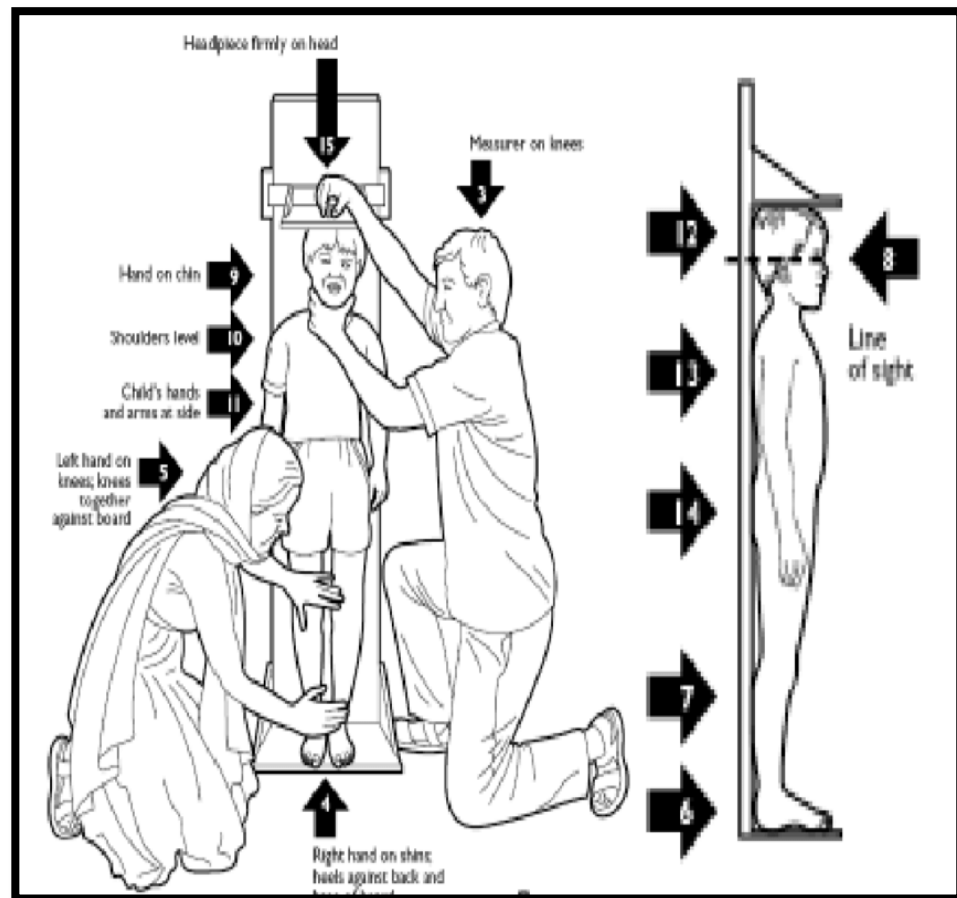


Figure 2.4: Height Measurement using Anthropometer (UN 1986)

Let us now move over to the head and chest circumference which has significance in understanding the nutritional stature of children.

3. Head Circumference

Measuring the head circumference is a standard procedure in pediatrics to detect the pathological conditions accompanied by a large head with hydrocephalus or too small skull with micro-cephalus.

Head size relates mainly to the size of brain which increase quite rapidly during infancy. Head circumference at birth is 35cm. It increases by 1 cm per month up to 6months. Later it increases by 4cm totally in the next 6 months. By one year it should be 45cm, by two years the head circumference is 47cm, by three years 48cm; by 5 years 50cm and by 18 years 55cm. Hence, the head circumference may also be used as a rough additional guide in assessing the age.

Equipments and Techniques

The head circumference is measured passing the narrow, flexible, non-stretching measuring tape made of fibre glass around the head over the supra - orbital ridges of the frontal bone in front and the most

prominent point of the occiput on the back of the head. Measurement should be made to the nearest 0.1cm.



Figure 2.5: Measurement of Head Circumference

4. Chest Circumference

The chest in a normally nourished child grows faster than head during the second and third year of life. As a result the chest circumference overtakes head circumference by about one year of age. As a result, between 6 months and 5 years the ratio of chest : head circumference will be < 1 may be due to failure to develop or to wasting of muscle and fat of the chest wall and can be used as an indicator of PEM. In such circumstances, due to poor growth of chest, the head circumference may remain to be higher than the chest even at the age of 2 ½ to 3 years.

Equipments and Techniques

A narrow, flexible and non-stretchable fibre glass tape is used. The chest circumference is taken at the nipple level preferably in mid inspiration. Measurement should be made to the nearest 0.1cm.

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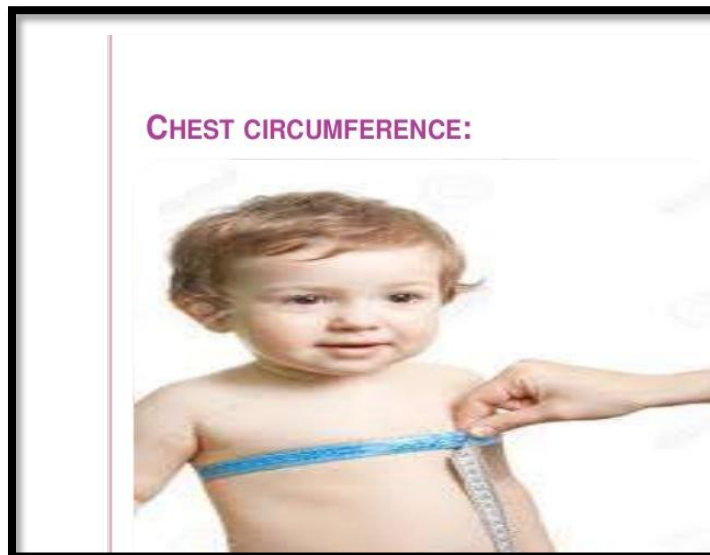


Figure 2.6: Measurement of Chest Circumference

Let us now discuss and find out how the mid upper arm circumference value reflects on the nutritional status.

5. Mid – Upper Arm Circumference(MUAC)

MUAC and calf circumference are indicators of status of muscle development. But, of the two MUAC is widely used because of the simplicity and easy accessibility in any age and gender and so is practical to measure. The arm circumference remains fairly constant between 1 to 5 years of age, hence this can be used as a tool not only to assess malnutrition but also to determine the mortality risk in children.

Instruments and Techniques

MUAC is taken on the left hand along the midpoint between the tip of the acromion of scapula and the tip of olecranon of the fore arm bone ulna with the arm flexed at the elbow at the right angle, and marked with a marker. The arm should be hung freely and measured using a flexible non-stretch measuring fibre glass tape. A measure below 12.5cm indicate severe PEM, 12.5cm to 13.5cm moderate PEM and above 13.5cm is considered well-nourished in children. The value should range between 27-30cm in adult women and 30-33 cm in adult men. This measurement is carried out using shakir's tape, quack stick or bangle test.

Let us go the next method of body measurement i.e subcutaneous body fat measurement.

6. Subcutaneous Body Fat Measurement.

The main store of energy reserves is subcutaneous fat. There is a close association between fatness and calorie reserves and between muscularity and protein status, which can be used as a tool to assess the gross nutritional status at specific life stages. The skinfold thickness

measurement helps in determining subcutaneous adiposity.

Instruments and Techniques

Skin fold callipers are considered as an efficient tool to measure the skin fold thickness at all necessary sites such as scapula, chest, triceps, biceps, abdomen, thigh, supra-iliac etc.

Some of the standard callipers used are Harpenden, Lange and Best, and USA-MRNL callipers. Una calliper is used in India. The standard contact pinch area of 20.40mm and an accuracy of 0.1mm is considered for selection. The instrument should exert a constant pressure of 10g/sq. mm throughout the skin fold thickness. The fat fold measured consists of a double layer of skin and fat. The fat fold parallel to long axis is picked up between thumb and fore finger of the left hand without including any underlying muscle and then the measurement is taken with the calipers. The techniques of measurement at various body sites are described in the Table 2.1.

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Table 2.1: The Techniques of Measurement at Various Body Sites

Site	Measurement
Sub Scapular	A diagonal fold is natural cleavage line just inferior to inferior angle of scapula with calliper applied 1 cm below
Suprailiac	An oblique fold is grasped behind to midaxillary line and above the iliac crest.
Triceps	Midpoint between acromion of scapula and olecranon of ulna is measured and vertical fold 1cm above line on posterior aspect of arm.
Biceps	Vertical skin fold is lifted over the belly of biceps brachii at the line marked for triceps, calliper is applied 1cm below finger.
Thigh	A point is located in the anterior midline of thigh between hip and knee joints.
Chest	The skin fold will run diagonally between shoulder and apposite hip.
Abdomen	A vertical point adjacent to the umbilicus is measured

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Fig 2.7 Harpenden Caliper



Fig 2.8 Lange Caliper

We have now learnt the different body measurements available and how to use the techniques we shall study in the following section how to interpret the anthropometric measurements to evaluate the nutritional status.

Interpretation of Anthropometric Measurements

Assessment of Children

The elementary measurements consisting of height, weight, skin fold thickness, head, chest and mid upper arm circumference can be expressed in numerous ways in relation to reference data and the outcome relates to the nutritional status.

1. Determination of Nutritional Status using Weight and Height

The following tables will help you to understand how to categorise the children into different grades of nutritional status using the anthropometric measurements taken on comparison with the reference values as indicated by National centre for Health Statistics (NCHS). The type and duration of malnutrition are well identified by using these classifications.

IAP (Indian Academy of Paediatrics) and ICMR classification

*Direct and Indirect
Methods of Nutritional
Assessment*

Table 2.2: IAP and ICMR Classification

Grades of Nutritional Status	% Weight for age of NCHS Standards
Normal	>80%
Grade – I	70-80%
Grade –II	60-70%
Grade – III	50-60%
Grade – IV	<60%

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IAP classification is extensively used for growth monitoring of children especially, in ICDS nutrition intervention programmes.

a) Gomez Classification

Table 2.3: Gomez Classification for weight for Age

Grades of Nutritional Status	% Weight for age of NCHS Standards
Normal	>90%
Grade – I	75-90%
Grade –II	60-75%
Grade –III	<60%

Gomez classification takes only body weight into consideration. The weights of the children are expressed as percent of the NCHS median value of reference population, which is assigned as 100%. But Gomez classification is not frequently used in India.

b) Waterlow's Malnutrition Classification

Table 2.4: Waterlow Classification

Types/ Degree of malnutrition	Cut of level as % of NCHS* Median Indicator	
	% Wt/Age	% Wt/Ht
Normal	> 90	>80
Short duration malnutrition	> 90	< 80 wasted
Long duration malnutrition (Nutritional dwarf)	< 90	<80 stunted
Current and long duration malnutrition	< 90	<80 stunted and wasted

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d) Kanawati and Mcharen’s Index of Thriving

Table 2.5: Kanawati and Mcharen’s Index of Thriving

S.No	Measurements	% range	Score
I. 1.	Weight	>100	0
2.	Mid arm circumference	90-100	1
		80-90	2
		70-80	3
		60-70	4
		<60	5
II. 1.	Height	>100	0
2.	Head circumference	90-100	1
		85-90	2
		80-95	3
		<80	4

The final score is calculated by adding individual scores for weight, mid arm circumference, height and head circumference.

Normal children - Index = 0-1, Failure to Thrive – Index=>9.

e) Jelliffe’s Classification: In 1965, Jelliffe has devised the weight for age sorting to ascertain the degree of malnutrition. 90-80% of expected weight for age shows 1st degree malnutrition, while 80-70%, 70-60%, <60% portray 2nd, 3rd and 4th degree of malnutrition respectively.

Assessment of PEM in Children

The following table will describe the different parameters in anthropometric measurements and how it helps to differentiate normal and children with Protein and Energy Malnutrition.

Table 2.6: Assessment of PEM in Children

Anthropometric Measurement	Normal	PEM
Wt in kg Rao index -----x100 (Ht in cm) ²	>1.5	<0.15 80-60% Kwashiorkor (with oedema) <60% marasmus (without oedema)
Skin fold thickness	>10mm	<6mm
Bangle test - 4.0cm diameter	Does not pass	Passes above the elbow
Mid Arm Circumference	16cm	Mild- 13.5cm Moderate -12.5cm severe <12.5cm
Shakir tape (MUAC)	Green Zone <13.5 -26cm	Moderate= Yellow Zone <12.5- 13.5cm Severe= Red Zone >12.5 cm

Kanawati index = MUAC	>0.32	Mild = 0.28-0.32 Moderate = 0.25-0.38 Severe = <0.25
Head circumference		
Chest circumference	>1.0	<1.0
Head circumference		
MAC/ Height Ratio	0.32-0.33	<0.29 Severe
The Quack Stick	Height < than the expected for measured MUAC	Height > than the expected for measured MUAC

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Although the parameters for assessing the nutritional status of children and adults are common, the interpretation of the measures differ. Hence, it is also important for us to know in detail the assessment of adults' nutritional status using anthropometric measures, which can be studied in the coming section.

Assessment of Adults

1. Body Mass Index (BMI)

Once the linear growth ceases around 21 years, weight for height indicates muscle -fat mass in the adult body. The ratio of weight in kg/ height² m is referred to as Body Mass Index or Quetelet Index, which provides an easy way to judge the nutritional category. BMI has good co-relation with adiposity, and indicates health risks at earlier stages itself. Table 2.7 shows the WHO classification of BMI.

Table 2.7 WHO classification of BMI.

WHO CLASSIFICATION OF WEIGHT STATUS	
WEIGHT STATUS	BODY MASS INDEX (BMI), kg/m ²
Underweight	<18.5
Normal range	18.5 – 24.9
Overweight	25.0 – 29.9
Obese	≥ 30
Obese class I	30.0 – 34.9
Obese class II	35.0 – 39.9
Obese class III	≥ 40

2. Weight and Hip Ratio

Waist to hip ratio gives distribution of fat in the human body, an indicator of central obesity. A waist hip ratio greater than 1.0 in men and 0.8 in

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women is indicative of android obesity and increased risk of atherosclerosis.

3. Broka’s Index

$$\text{Broka's Index} = (\text{Ht in cms} - 100) = \text{Ideal Weight in kg}$$

Broka’s Index is simple and easy to use index for the assessment of nutrition status of adults. Broka’s index correlates with BMI and also weight and height.

The best combination of measurements found useful for the measurement of the growth and health status of infants, pre – school and school age children, adolescents and adults are given in Table 2.8

Table 2.8: Best Set of Anthropometric Measurements/ Indices for Assessing Nutritional Status

Details	Measurements / Indices
Newborns	Weight, height , weight for height (%) or weight /height ²
Infants	Weight, height , weight for height (%) or weight /height ² , head and chest circumference
Pre-school children	Weight, height , weight for height (%) or weight /height, ² arm and calf circumference
School age children and adolescents	Weight, height , weight for height (%) or weight /height ²
Adults	Weight for height (%) weight/height ² , Weight/ height , Weight/ height ³ or Broka’s index

Source: Visweswara Rao, K.1999, Biostatistics.

For screening short - term malnutrition at a high level of specificity, weight for height is superior to weight for age. For monitoring malnutrition for long – term periods, with the usual random errors in age data, weight for age is better. For those interested in assessing the type and duration if malnutrition, waterlow’s classification is recommended.

Merits

- Anthropometric measurement can easily be carried out without much technical knowledge.
- The results can be interpreted easily and immediately.
- This is the most inexpensive method.
- It is faster and not time consuming.
- This method can be done even in a remote village where no facilities are available.
- It has no side effects.
- It is non- invasive and better cooperation can be achieved from the

community.

Demerits

- The results may not be accurate if the instruments used are not calibrated properly.
- This may not be the conclusive method and another method may be needed to support.
- Standards need to be revised constantly.

One cannot use the same percentiles for height and weight and skin folds for early maturers, late maturers and those of intermediate maturing timing. This limitation is inherent in existing standards.

So, we have learnt about the nutritional anthropometry as one of the direct methods to assess nutritional status of children and adults. We will move on to the next direct method of assessment biochemical indices.

Check Your Progress

- 1. Relate the sequence of nutritional deficiency to assessment of nutritional status.**
- 2. Name the methods used to assess nutritional status.**
- 3. How do you assess PEM in children?**

2.2.1.2 Biochemical Assessment

Biochemical methods are more clear-cut, independent and reflective methods for evaluation of nutritional status than any other method. In the development of any deficiency disease, biochemical changes can be expected to occur prior to clinical manifestation. Therefore biochemical tests which can be conducted on easily accessible body fluids such as blood urine, can help to diagnose disease at the subclinical stage. These tests confirm clinical diagnosis if symptoms are non-specific. However, the interpretation of biochemical data is often difficult.

Laboratory tests for nutritional assessments include:

- To measure individual nutrient concentration in body fluids.
- To detect the abnormal amounts of metabolites in urine frequently after a loading dose
- Helps in the measurement of activity of vitamin-dependent enzymes in which the vitamin is a known co-factor (riboflavin deficiency) to help establish malnutrition in its preclinical stages.

Although, it is not feasible to assess all the biochemical parameters in a nutritional survey it is recommended to determine the following values to assess the nutritional status.

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- Serum albumin level.
- Iron, Folacin, Vitamin B6 and B12 which help in formation of blood.
- Fat soluble vitamin A and D in blood.
- Blood and urinary glucose levels to determine diabetes.
- Blood lipid profile which includes cholesterol and triglycerides indicative of heart disease.

When the dietary history is unavailable or cynicism of nutritional deficiencies arises, biochemical tests are done to detect the marginal deficiencies in individuals, even before the clinical signs of the diseases appear, so as to permit the initiation of appropriate remedial measures.

Biochemical tests for nutritional deficiencies

We shall take a look at the different biochemical tests used for detecting nutritional deficiencies.

Tests for Protein Energy Malnutrition

Tests like serum proteins, serum amino acid ratio, urinary hydroxyproline index, urinary creatinine height index, urea-creatinine ratio are used to assess protein nutritional status.

Serum Proteins

The first indication of malnutrition is the lowering of serum total proteins and serum albumin. The normal albumin levels are 3.5-5.5 g/dl. During PEM the levels may slow down to 2.0-2.5 g/dl. α globulin and γ globulin fractions show a small rise but the albumin globulin ratio shows a tendency to decrease. Serum transferrin $<0.45\text{mg/ml}$ suggests severe malnutrition.

Serum Amino Acid Ratio

This ratio of non-essential /essential amino acids is very sensitive at an early stage of PEM as also for kwashiorkor. This test is not sensitive to marasmus.

$$\text{Serum Amino Acid Ratio} = \frac{\text{Glycine} + \text{Serine} + \text{Glutamine} + \text{Taurine}}{\text{Leucine} + \text{Isoleucine} + \text{Valine} + \text{Methionine}}$$

Normal mean value	-	15
Subclinical malnutrition	-	2 to 4
Frank kwashiorkor mean value	-	5

Urinary Hydroxyproline Index

$$\text{Hydroxyproline Index} = \frac{\alpha \text{ micro moles hydroxyproline /ml}}{\alpha \text{ micro moles creatinine/ ml/ kg body weight}}$$

Urinary Creatinine Height Index

The measurement provides an approximate idea of the musculature of the child and it is of value in assessing the recovery of malnourished children as well as in the detection of marginal nutrition.

mg creatinine /24 hour
excreted by the malnourished child
Urinary Creatinine
Height Index = -----x100
mg creatinine /24 hour excreted
by a normal child of the same height

Normal and recovery from PEM	-	1
Kwashiorkor and marasmic kwashiorkor	-	0.24 to 0.75
Marasmus	-	0.33 to 0.85

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Fasting Urinary Urea Nitrogen and Creatinine Nitrogen Ratio

Mg urea nitrogen /ml
Urea Creatinine Ratio = -----
Mg creatinine nitrogen/ml

Children eating diets low in protein show low ratios of urinary urea to creatinine

Table 2.9 Biochemical Methods for Assessing Nutritional Status

Nutrients	Principal method	Normal	Deficiency
Vitamin A	Serum Vitamin A Relative Dose Response Test (450-1000µg retinol) 100µg/kg dehydroretinol; Dehydroretinol: Vitamin A	30 µg /dl - -	<20 µg/gl >20% RDR >0.06
Vitamin D	S.25,hydroxy cholecalciferol	>10ng/ml	<5 ng/ml
Vitamin E	Serum vitamin E/total lipid ratio	>0.8	-
Vitamin K	Protein induced by vitamin K absence PIVKAS	Absent	Accumulate
Thiamine	Urinary thiamine Erythrocyte Transketolase test (ETK-AC) Activated coefficient	100µg/24hr 65 µg/ of creatinine <1.15	- >1.25
Riboflavin	Erythrocyte glutathione reductase (EGR -AC)	<1.2	>1.4
Niacin	N-Methyl 1-2 pyridone -5 carboxylamide (2 pyridone) and N1 - methyl nicotinamide ratio	1-4	<1.0

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VitaminB ₆	Urinary excretion B ₆ Erythrocyte asparatate amino tranferase (EAspAT-AC)	<1.7 – 2.0	<20µg/g creatinine -
Folic acid	Serum folate RBC folate Formimino glutamic acid FIGLU	>6.0 ng/ml >160ng/ml <20mg FIGLU in 8 hours after histidine load of 0.26 g/kg body weight	<3.0ng/ml <140ng/ml >100mg
VitaminB ₁₂	Serum B ₁₂	200- 900pg/ml	80pg/ml
Ascorbic acid	P. Ascorbic acid levels Leucocyte ascorbic acid	>0.3 mg/dl >15mg/dl	<0.2mg/dl <8 mg/dl
Iron	Serum ferritin levels Serum iron Serum transferrin Haemoglobin	- - - >13g/dl (Men) >12g/dl (Women)	12 µg/l <40 µg/dl <0.16 - -
Iodine	Urinary excretion of Iodine	>50mg/g creatinine	-
Zinc	Plasma Zinc	84-104 µg/dl	-
Copper	Serum Copper	75-125 µg/dl	-

Source: Textbook of Human Nutrition, BamjiMehtab, 2009

The biochemical assessment thus, has various implications that we have discussed, on fields while assessing nutritional status. As known, every method has its own limitations, and the limitations of biochemical methods are discussed below.

Limitations of Biochemical Assessment

- Time consuming and expensive.
- They cannot be applied on whole community ie. Large population
- To perform tests, experienced and well trained experts are needed.
- Most tests reveal only current nutritional status.
- It is invasive method, so sample collection is hazardous.

- Standard reference values and standardized specific tests for specific nutrients are needed.

Having studied about the biochemical assessment we shall now study about the biophysical or radiological assessment of nutritional status.

2.2.1.3 Biophysical

Biophysical or radiological tests are used in specific studies where additional information regarding change in the bone or muscular performance is required. This methods works on the principles of biophysics and methods like radiological examinations, physical functional assessment and cytological methods are generally used for these purpose. These methods have been used in studying the change of bones in rickets, osteomalacia, osteoporosis and scurvy.

When clinical examination suggests a specific malnutrition following radiographic examinations can be done:

- In rickets, there is healed concave line of increased density at distal ends of long bones usually the radius and ulna.
- In infantile scurvy there is ground glass appearance of long bones with loss of density.
- In beriberi there is increased cardiac size as visible through X-rays.
- Changes in bone also occur in advanced fluorosis.
- Endocardiograph, is used for graphing heart sounds and a means for measuring nutritional status.
- Cytological tests of stained epithelial tissue smears obtained from buccal mucosa indicated changes in nutritional status. These examinations help reveal Vitamin A deficiency, dehydration or febrile condition.

Merits

The results are more accurate and can be used as a supporting data for other methods.

Limitations

- Instruments required are expensive.
- Technical knowledge is a must to interpret data.
- It is difficult to transport the equipment to interior parts of a remote area or villages.

Though a laborious one, biophysical methods due to the advancements and precision of results prove welcoming.

Now, we shall pass on to the next method of assessing nutritional status- clinical assessment.

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2.2.1.4 Clinical Assessment

Clinical examination assesses levels of health of individuals or of population groups in relation to the food they consume. It is the simplest and practical method. The assessment of changes that can be seen or felt in superficial epithelial tissues, especially skin, eyes, hair and buccal mucosa, believed to be related to inadequate nutrient intake is termed as clinical assessment. When two or more clinical signs characteristic of a deficiency disease are present simultaneously their diagnostic significance is greatly enhanced. Occasionally, this may be supplemented in the field with certain physical tests, with or without instrumental aids such as the testing of ankle jerks.

The WHO classification of signs associated with malnutrition helps to identify particular nutritional deficiency when the survey requires rapid screening. They have been classified into 3 groups as tabulated below:

Group I: Signs that are considered to be of value in nutritional assessment. These are often associated with nutritional deficiency. Signs of malnutrition may be mixed and may be due to the deficiency of two or more micronutrients.

Group II: Signs that require further investigation. They may be related to chronic malnutrition, where health and environmental problems coexist.

Group III: The signs need not necessarily correlate with malnutrition.

You will be able to understand if you look into the following table which clearly indicates the clinical signs and symptoms associated with signs and nutrients deficit.

Table 2.10: Clinical Signs and Symptoms Of Nutritional Inadequacy

Sites	Sign & Symptoms	Deficiency
General Appearance	Loss of Subcutaneous Fat , Sunken or Hollow Cheeks	Protein – Energy, Fluid
Hair	Easily Plucked Hair, Alopecia Dry, Brittle Hair Corkscrew Hair	Protein Protein, biotin Vitamin C
Nails	Spooning Transverse Lines Dry And Scaly Flaky Paint	Iron Protein Vitamin A , zinc
Skin	Nasolabial Seborrhoea Psoriasis Form Rash Pallor Follicular Hyperkeratosis Perifollicular Haemorrhage Easy Bruising Hyperpigmentation	Essential fatty acid, riboflavin m pyridoxine Vitamin A, zinc Iron, vitamin B ₁₂ , Folate Vitamin A, Essential Fatty Acid Vitamin C Vitamin K or C Niacin

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Eyes	Night Blindness Photophobia, Xerosis, Conjunctival Inflammation Retinal Field Defect	Vitamin A, zinc Riboflavin, Vit A Vitamin E
Mouth	Glossitis Bleeding Gums Angular Stomatitis, Cheilosis Decreased Taste Or Smell Tongue Fissuring Tongue Atrophy Loss Of Tooth Enamel	Riboflavin, Pyridoxine, Niacin, Folate, Vitamin B ₁₂ , Iron Vitamin C, Riboflavin, Pyridoxine, Niacin Zinc Niacin Riboflavin Niacin, Iron Calcium
Neck	Goitre Parotid Enlargement	Iodine Protein
Heart Chest	High Output Failure Respiratory Muscle Weakness	Thiamine Protein, Phosphorus
Abdomen	Ascites Hepatomegaly	Protein Protein, Energy
Extremities	Oedema Ataxia Bone Tenderness Bone/ Joint Pain Muscle Pain Hyporeflexia Muscle Wasting and Weakness Joint Swelling	Protein, Thiamine Vitamin B ₁₂ Vitamin D, Calcium Phosphorus Vitamin A Or C Thiamine Thiamine Protein Calorie, Vitamin D, Selenium, Sodium Chloride Vitamin C
Thorax Muscles	Thoracic Roasary Atrophic Muscles Decreased Grip Strength	Vitamin D Protein Protein
Neurological	Dementia Acute Disorientation Nystagmus Ophthalmoplegia Wide - Based Gait Peripheral Neuropathy Loss Of Vibratory Sense Loss Of Position Sense Tetany Paresthesias	Thiamine Vit B ₁₂ , Folate, Phosphorus, Niacin Thiamine Thiamine Thiamine Thiamine, pyridoxine, vitamin E Vitamin B ₁₂ Vitamin B ₁₂ Calcium Magnesium Thiamine, Vit B ₁₂

	Wrist Or Foot Drop Diminished Reflexes	Thiamine Iodine
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Source: Shils Maurice, et. al (Editors), 1998, Modern Nutrition in Health and Disease.

Merits

- Relatively inexpensive method.
- Field equipments or a laboratory is not required.
- Simplest and most practical method.
- Gives valuable information to public health workers.

Limitations

- Proper trained personnel is required.
- Non-specific signs may be falsely related to nutritional deficiencies.
- Early signs and symptoms are vague and often include weakness, lethargy, irritability etc.
- The procedure is non-invasive and co-operation of subjects can be achieved easily.

Check Your Progress

4. Mention the clinical signs associated with Neurological conditions.

5. Discuss the biochemical assessment of PEM.

With a clear understanding of clinical method of assessment we shall study the next important method i.e. Diet Survey.

2.2.1.5 Diet Survey

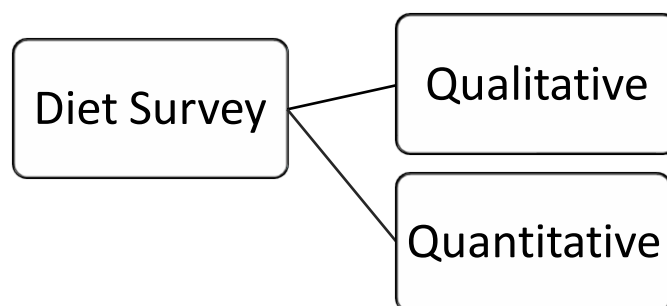
In determining the health and nutritional status of a community diet plays a vital role. As we have discussed in our earlier chapter there are several factors which determine the choice of food of people belonging to a community. Thus, diet survey proves to be an effective tool to determine the nutritional status of a community.

Scope and Purpose

- Diet survey provides a systematic enquiry into food supplies and food consumption patterns of the community.
- Acts as an aid to interpret the anthropometric, biochemical, biophysical and clinical findings.

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Types of Diet Survey



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Diet survey can be conducted by two types of approaches. You can easily understand from the name itself, that the **Qualitative approach** stress on the study about the qualitative approach towards food like the type of foods consumed, opinion and attitude to foods, cultural implications on food and food practices under special physiological conditions like pregnancy, lactation, infancy and old age, while **Quantitative approach**, attempts to quantify the foods and beverage in terms of amount consumed and obtaining the relative nutritive value. Comparison of nutrient intake with RDA provides a measure of adequacy or inadequacy of foods consumed in a particular region.

Methods of Diet Survey

Although qualitative approach provides sufficient information regarding food practices of a population it is only the quantitative approach which helps to assess the nutritional status in a more precise manner. Therefore, most of the methods of diet survey applies both qualitative and quantitative approaches to ensure accuracy.

We shall now focus on the different methods of diet survey used frequently to assess nutritional status stating their advantages and disadvantages.

1. Food Weighment Method

In this method, food either raw or cooked is actually weighed using an accurate balance. It is ideal to conduct the survey for seven consecutive days to know the true picture of diet.

Every day food is weighed in the morning and evening before actual cooking is begun. Only edible portion of raw food is weighed. Consumption of food by guests and additional food consumed by the family members like those brought in a cooked form, food accepted from friends and relatives should be noted with the details. Survey should

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not be done on fast and festival days. Age sex and physiological status of all family members who consume the food should be noted down.

Foods are converted into nutrients by referring to food composition tables. The nutrient intakes thus can be expressed per consumption unit (CU) or per capita. The calorie requirement for one consumption unit is 2400Kcal.

The calorie coefficient as recommended by ICMR is given in the table 2.11

Table 2.11 Calorie Coefficient for Computing Calorie Requirement of Different Age Groups

Age Group	Consumption Unit (C.U)
Adult man (Sedentary)	1.0
Adult man (Moderate)	1.2
Adult man (Heavy)	1.6
Adult woman (Sedentary)	0.8
Adult woman (Moderate)	0.9
Adult woman (Heavy)	1.2
Adolescent 13-21 years	1.0
Children 9-12 years	0.8
Children 7-9 years	0.7
Children 5-7 years	0.6
Children 3-5 years	0.5
Children 1-3 years	0.4

$$\text{Intake of food/CU/day (g/ml)} = \frac{\text{Raw amount of each food (g/ml)}}{\text{Total C. U x No. of days of Survey}}$$

If a household consists of an adult sedentary male, moderate working adult female, an adolescent boy, a 3 year old girl, then the total Consumption Unit of the family = (1.0+0.9+1.0+0.5=3.4)

If the family has cooked and consumed 1500gms of raw rice for a day, the approximate intake of rice per C.U per day = 1500/3.4=441 gms.

Advantages

- Involves direct weighing of foods, hence relatively an accurate method.
- Simple method.

Disadvantages

- Time consuming and needs co-operation of cooking personnel throughout the study period.
- Coefficient for computing intake holds good only for calories and cannot be calculated for other nutrients like proteins, vitamins, minerals etc.

- Precise consumption level of specific age group within the family cannot be assessed.
- The surveyor has to stay in the place of survey.

Let us review the next method, 24 hour recall method.

2. 24- Hour Recall or Oral Questionnaire Method

This method is employed to collect dietary intake data of individuals in large nutritional surveys. The dietary data is obtained from the respondent (the person who cooks), through an oral questionnaire, he / she is asked to recapitulate details related to food intake like what was eaten, when was it eaten, how much of food was prepared and how much eaten.

In this method, a set of standardized cups suited to local conditions are used. Information on the total cooked amount of each preparation is noted in terms of standardized cups. The intake of each food item by the specific individual in the family such as the preschool child, adolescent girl or pregnant or lactating woman is assessed by using the cups. The cups are used mainly to aid the respondent recall of the quantities prepared and fed to the individual members.

The cooked food intake by individual family member is converted to raw amount of each food item, which can be calculated by using the formula:

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

Advantages

- Inexpensive, quick to administer, provides detailed information on specific foods.
- Requires to remember foods consumed only for the past 24- hours, so provides accurate data.
- No need to maintain dietary records, so time and effort of the respondent is saved.
- Respondents co-operate well.
- It is used together with food frequency method to cross check.

Disadvantages

- Not a reliable indicator of food intake.
- If eating patterns are irregular, it is difficult to recall.
- The estimated portion size is likely to vary.
- The recall day may not be typical of the usual intake.
- Respondent may withhold or alter informations about they ate.

The next method of diet survey is diet history method, which is considered as an effective method for assessing nutritional status, is performed as discussed below.

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3. Diet History Method

Diet history method helps to obtain qualitative information on long-standing food habits. This method was developed by B.S.Burke and involves 4 steps:

Step 1: Collection of general information about the subjects' food and health status.

Step 2: 24 hour recall method is applied to get information on usual eating habits.

Step 3: Performance of a cross-check on the data given in step 2.

Step 4: 3- day records on the subjects are collected.

Advantages:

- This method has been used to study the meal patterns, dietary habits, peoples food preferences and /or avoidances during physio pathological conditions like pregnancy , lactation, sickness etc.
- Infant weaning and breast feeding practices and associated culture constrains which are often prevalent in the community can also be studied by this method.
- At times information on approximate quantities of food, consumed by the households like 30kg of rice per month or half alitre of milk per day can also be collected.

Disadvantages:

- Requires more time and money.
- Highly trained interviewers are needed.
- The data may not be reliable.
- Estimates of dietary intake from this method tend to be higher than those weighed from weighed record.

Now, we shall discuss the expenditure pattern method, which is used in National Sample Survey to collect information on food consumption.

4. Expenditure Pattern Method

In this method, money spent on food as well as non -food items is assessed by administering a specially designed questionnaire. The reference period could be either a previous month or week.

Advantages:

- This method, apparently is less cumbersome as it avoids actual weighing of foods.
- In trained hands, both weightment and expenditure pattern methods yield comparable results.

Disadvantages:

- The reference period is usually toolonger.
- The information on foods bought by the family, need not

always give the actual mean consumption.

5. Food Inventory Method

Food inventory method also known as institutional diet survey is employed in institutions like hostels, army, barracks, orphanages and homes for the aged, where homogenous groups of people take their meals from a common kitchen. In this method, the amount of food stuff issued to kitchen as per the records maintained by the warden are taken into consideration, along with the number of individuals partaking the meal. A reference period of one week is desirable. Average intake per person per day can be calculated as follows:

Stocks at the beginning of the week –

Stocks at the end of the week

$$\text{Average intake /person/ day} = \frac{\text{Stocks at the beginning of the week} - \text{Stocks at the end of the week}}{\text{Total no. of inmates partaking the meal} \times \text{number of days of survey}}$$

Advantages:

- Large samples can be covered in a short time.
- Food consumption in institutional settings can be found.

Disadvantages:

This method is possible only when the community is fairly educated and submits on cash economy where food is usually purchased from the market.

6. Food Balance Sheets

This method is employed when information regarding the availability of food is needed at macro level -region or country.

Advantages

Food balance sheets are most useful for administrators and planners to monitor food position in the country and to take appropriate decisions.

Disadvantages

This method is of little use to health / nutrition workers since the actual dietary consumption will not be known from the balance sheets.

7. Food Frequency Checklists

The next method of diet survey is the food frequency checklist which ascertains how often an individual eats a specific type of food by interview or checklist method. A food frequency checklist consists of two components: a food list and a frequency response section, with approximately 100 or fewer individual food or food groups that are important contributor to a population's nutrient and energy needs. Usually,

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these foods are grouped into categories on the basis of nutritive value or bodily functions.

Advantages

- When used with 24 hour recall method, food frequency checklist enables the assessor to double the accuracy of information obtained.
- Relatively inexpensive and quicker to administer in large population survey.
- Preferred method to conduct research on diet-disease relationship on macro and micro nutrient levels.

Disadvantages

The number of foods is limited to 100, and hence the chosen foods must be a representative of common foods consumed by the subjects.

8. Chemical analysis/ Duplicate Sample Method

The subjects weigh and record their food at the time of consumption and a duplicate of the diet is weighed and stored and then sent to laboratory for nutrient analysis.

Advantages

- This is the most accurate method of diet survey.
- This is the direct method of nutrient analysis and there is no need of food consumption tables or any other tools.
- This method is widely used in metabolic balance studies.

Disadvantages

- Very expensive method.
- Requires intense supervision.
- Good laboratory support is a must.

9. Dietary Score

The next method of diet survey to be studied is dietary score, which involves assigning an arbitrary scores to the foods on the basis of its nutrient content. The consumption of the particular food by an individual is estimated through frequency method. For eg. The grading of food is done according to the major sources of a specific nutrient. In case of protein, the score for egg is 3, fish 2 and pulses 1. The frequency of consumption of foods, the total scores and percentages are then calculated. The value of this qualitative method enhances when it is combined with other quantitative diet survey methods.

Advantages

This is a very simple method.

Disadvantages

- Time consuming.
- Knowledge on scoring system is required.

10. Food Intake Record or Food Diary Method

This method involves maintenance of dietary records of weighed quantities of food consumed by an individual/family according to the number of days of survey. Generally, a 3 day record or 7 day record is recommended. A record for 7 days is called as one dietary cycle. Along with food intake, time of intake, place where eaten, mood while eating, frequency of intake of each food are recorded.

Advantages

- The food and beverage consumed can be recorded immediately, hence accuracy is well established.
- Detailed food intake, life style and factors that affect food intake can be obtained.
- The causes for food allergies can be easily identified.
- Factors associated with dietary imbalance can be traced.

Disadvantages

- Respondent needs to be a literate.
- Accuracy in estimation of portion size requires knowledge and skill.

Having discussed all the methods under diet survey, we shall now sum up the problems bump into in diet surveys.

Problems in Diet Survey

Even though well planned, diet survey may face some problems related to data collection methods, analysis and interpretation. Some of the problems encountered by field investigators like nutritionist / dietician/ social scientist during the process may include:

- Memory lapse.
- The reporting period is long which leads to lots of errors.
- Non response due to non-co-operation of the subjects.
- Errors arising from crude local measures(inventory method)
- Inaccurate weighing of food stuffs(weighment method)
- Seasonal variations and improper selection of reporting period.
- Response error arising as a result of deviation from normal food consumption pattern during the survey period.
- Lack of knowledge in the use of food composition tables.
- Remote or unapproachable area of survey.
- Lack of rapport with the respondent.
- Long duration of survey.
- Inconvenient timing of survey.
- Lack of trained personnel.
- Lack of instrument assistance.

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- Delay in data processing and interpretation of results due to lack of technical skills.

In order to overcome the above problems the following points should be taken into consideration:

- A pilot survey is needed.
- Proper communication and transport facilities to the area of survey should be ensured.
- Prior orientation about the survey to the subjects will facilitate good rapport.
- Sample size for diet and nutritional survey should be in the ratio of 1:4 or 1:5 depending on the objective of the survey.
- Erstwhile knowledge of field situation will help in formulating questionnaires, checklist and guidelines.
- Mid-term appraisal shall be conducted in case of need.

So far, we learnt about the methods of dietary assessment, the advantages and its limitations in nutritional assessment. Now we shall move to the next direct assessment method-Functional Assessment.

2.2.1.6 Functional Assessment

Functional assessment is used to assess changes in functions co-related with nutrient inadequacy. The nutritional sufficiency of the cells, tissues, organs and anatomical systems to accomplish their biological functions is assessed by this method. Functional indices of nutritional status include cognitive ability, disease response, reproductive competence, and physical activity, and work performance, social and behavioural performance.

Functional indices, which have many potential advantages over static indices in respect to validity of information related to nutritional status are described below:

- **Submaximal test**, using tread mill, which assesses cardiac efficiency, work performance and respiratory capacity might be useful as an adjunct to biochemical and anthropometric measures in the assessment of nutritional status.
- **Fertility rate and birth weight of the infant**, reflects nutritional status at the population level.
- **Lactation performance**, is another functional index of individual nutriture. Milk volume, fat and total energy content of milk is reduced in malnourished women.
 - **Social performance**: The ability of an individual to interact with his or her peers and environment serves as an index for functional nutritional status evaluation. Prenatally undernourished infants show several behavioral impairments that could negatively affect the development of social competence including reduced activity and less interaction with caretakers.

Table 2.12 Functional Indices of Nutritional status

System	Nutrients involved
Structural Integrity Erythrocyte fragility Capillary fragility Tensile strength of skin Experimental wound healing Lipoprotein peroxidation	Vitamin E, selenium Vitamin C Copper Zinc Vitamin E
Host Defence Leucocyte phagocytic activity Leucocyte metabolism White cell interferon production	Protein, energy , iron Protein, energy Protein, energy
Transport Intestinal absorption Iron absorption Cobalt absorption Plasma tissue transport Zinc uptake by erythrocyte Retinol relative dose response	Iron Zinc Vitamin A
Hemostasis Prothrombin time Platelet aggregation	Vitamin K Vitamin E, zinc
Reproduction Sperm count	Energy, zinc
Nerve function Dark adaptation Olfactory acuity Taste acuity Nerve conduction	Vitamin A, zinc Vitamin A, B ₁₂ , zinc Vitamin A, zinc Protein, energy, Vitamin B ₁ , B ₁₂
Work Capacity Hemodynamics Task performance endurance Heart rate (Cumulative)	Protein, energy, vitamin B ₁ , B ₂ , B ₆ and iron Protein, energy and iron

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Source: Solomon's Noel and Lindsay H, Allen 1983. The Functional assessment of nutritional status: Principles practice and potential, Nutrition, Reviews, 41.2.

Table 2.12 depicts a detailed discussion on the parameters of the functional indices, the nutrients and the systems involved.

Check Your Progress

- 6. Write as short note on 24-hour recall method**
7. Describe functional assessment.

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A deep insight has been provided on the different direct methods of assessment of nutritional status. We shall next look into the indirect methods used for nutritional assessment.

2.2.2 INDIRECT ASSESSMENT METHODS

When direct assessment methods are not employable, we opt for indirect assessment methods especially to assess the nutritional status of a very large group of population. They help in retrospective studies and the results obtained helps to enrich other methods of nutritional survey.

As we know, the indirect methods used frequently are vital statistics and Ecological factors assessment. Let us learn each method in detail.

2.2.2.1 Vital Statistics

The term vital statistics signifies the data and analytical methods for describing the vital events occurring in communities such as birth, illness, marriage, migration, morbidity and mortality within a population, which are again influenced by the nutritional status. A wide range of vital statistics may be considered as indirect indicators of nutritional status of the community are discussed in the following pages.

Parameters used under vital statistics are

- Measures of Morbidity
- Measures of Mortality

Let us converse each one in detail.

- **Measures of Morbidity**

Morbidity relates to types and varieties of disease one faces or experience affecting the day to day activity.

The following measures are used to quantify morbidity.

$$\text{Incidence rate} = \frac{\text{Total number of new cases Of a specific disease during the year}}{\text{Midyear population}} \times k$$

$$\text{Prevalence rate} = \frac{\text{Total number of old cases existing at a point of time}}{\text{Total population at that point of time}} \times k$$

Where k can be, 100 or 1,000, 10,000 or 1, 00,000.

Case fatality ratio and immunity ratio are also measures of morbidity.

- **Measures of Mortality**

a) **Infant Mortality Rate (IMR):** This is the number of babies dying in the first year of life per 1000 live births. The IMR is falling as there is improvement in infant feeding. In most prosperous countries the rate lies between 10 and 20. In India the rate is 80 per 1000 live births.

No. of deaths under one year of age in a year

$$\text{IMR} = \frac{\text{No. of deaths under one year of age in a year}}{\text{No. of live births in a year}} \times 1000$$

- b) **Perinatal Mortality Rate (PNMR):** This is the number of deaths of infants under one month and stillbirths per 1000 total births. This rate gives an index of maternal nutrition through many other factors like genetic make-up of mother and child, the degree of exposure to infections and the standard of medical care available.

$$\text{PNMR} = \frac{\text{Late foetal deaths after 28 weeks or more gestation} + \text{Deaths under one week}}{\text{Mid-year population of the same age group}} \times 1000$$

in the same year

- c) **Toddler Mortality Rate (TMR):** The number of deaths between 1 to 4 years per 1000 toddlers born is known as toddler mortality rate. The manifestations and effects of malnutrition are well known to be severe in toddlers.

Under the indirect methods, next in turn comes the assessment of ecological factors, which encompass several parameters. Each one can be noted in detail.

2.2.2.2 Assessment of Ecological Factors

Ecology plays a vital role in maintenance of nutritional status, which we have discussed in unit- 1 under food security. The ecological factors related to the aetiology and prevention of malnutrition include:

- a) **Conditioning Infections:** Nutrition and infection is a vicious cycle that will be studied in detail in unit- 4. The commonly associated infections with malnutrition are
Bacterial: T.B, whooping cough, diarrhoeal diseases and dysentery
Viral: Measles
Parasitic: Malaria, Ascariasis
Protozoal: Amoebiasis
- b) **Cultural Influences:** Food attitudes, meal pattern, and local concepts on causation, prevention and cure of diseases all significantly contribute to nutritional status.
- c) **Socio-Economic Factors:** Demographic factors, Literacy levels, Housing and sanitary amenities, water supply, sewage, occupation, income, expense towards food are the socio-economic factors convenient to consider to assess the nutritional status.
- d) **Health and Educational Services:** The following information on health and educational services are useful in indirect assessment of nutritional status:
 Information on number of hospitals, number of beds, record keeping, number of maternal, children and geriatric admissions, diagnosis,

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prognosis, methods of treatment, food and nutritional rehabilitation centres available and services provided.

Also, the number of schools, number of students' enrolment, attendance, literacy rate, mass media availability and usage also indirectly help to assess the nutritional status.

Though the indirect assessment methods are available they are less reliable than the direct methods. The results of nutritional prevalence survey vary greatly in complexity, depending on the type and number of staff, the time available, purpose of investigation and on the quality of information sought from the respondent. Hence, it can be concluded that the direct methods of nutritional assessment can be used primarily and the indirect methods can support to enhance the validity of assessment.

Check Your Progress

8. What is toddler mortality rate?

9. Name the ecological factors that help to assess nutritional status.

2.4 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

1.

Nutrient Depletion Sequence	Assessment Methods
Dietary inadequacy ↓	Dietary assessment
Tissue reserve store decreases ↓ Body fluid level decreases ↓ Decrease in nutrient dependent enzymes ↓	Biochemical estimation
Functional performance decrease ↓	Biophysical, functional
Change in Clinical signs and symptoms ↓	Clinical examination
Anatomical Sign ↓	Anthropometry
Morbidity, Mortality	Vital health statistics

2. Direct methods- Anthropometry, Biochemical and

Laboratory estimation, Biophysical or radiological examination, Clinical examination, Dietary survey, Functional assessment.

Indirect Methods - Vital health statistics and Ecological factors assessment.

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Anthropometric Measurement	Normal	PEM
Wt in kg Rao index -----x100 (Ht in cm) ²	>1.5	<0.15 80-60% Kwashiorkor (with oedema) <60% marasmus (without oedema)
Skin fold thickness	>10mm	<6mm
Bangle test - 4.0cm diameter	Does not pass	Passes above the elbow
Mid Arm Circumference	16cm	Mild- 13.5cm Moderate - 12.5cm severe <12.5cm
Shakir tape (MUAC)	Green Zone <13.5 - 26cm	Moderate= Yellow Zone <12.5- 13.5cm Severe= Red Zone >12.5 cm
Kanawati index = MUAC Head circumference	>0.32	Mild = 0.28-0.32 Moderate = 0.25-0.38 Severe= <0.25
Chest circumference Head circumference	>1.0	<1.0
MAC/ Height Ratio	0.32-0.33	<0.29 Severe
The Quack Stick	Height < than the expected for measured MUAC	Height > than the expected for measured MUAC

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4.

Neurological Symptoms	Nutrients Deficit
Dementia	Thiamine Vitamin B ₁₂ , Folate,
Acute Disorientation	Phosphorus, Niacin
Nystagmus	Thiamine
Ophthalmoplegia	Thiamine
Wide - Based Gait	Thiamine
Peripheral Neuropathy	Thiamine, pyridoxine, vitamin E
Loss Of Vibratory Sense	Vitamin B ₁₂
Loss Of Position Sense	Vitamin B ₁₂
Tetany	Calcium Magnesium
Paresthasias	Thiamine, Vit B ₁₂
Wrist Or Foot Drop	Thiamine
Diminished Reflexes	Iodine

5. Tests like serum proteins, serum amino acid ratio, urinary hydroxyproline index, urinary creatinine height index, urea-creatinine ratio are used to assess protein nutritional status.

6.24- Hour Recall or Oral Questionnaire Method: In this method, a set of standardized cups suited to local conditions are used. Information on the total cooked amount of each preparation is noted in terms of standardized cups. The intake of each food item by the specific individual in the family such as the preschool child, adolescent girl or pregnant or lactating woman is assessed by using the cups. The cups are used mainly to aid the respondent recall of the quantities prepared and fed to the individual members.

Total raw amount for each food item (g)

X individual cooked intake (vol)

Individual raw intake= -----

Total cooked amount of the preparation (vol)

7. Functional assessment is used to assess changes in functions co-related with nutrient inadequacy. The nutritional sufficiency of the cells, tissues, organs and anatomical systems to accomplish their biological functions is assessed by this method. Functional indices of nutritional status include cognitive ability, disease response, reproductive competence, physical activity, work performance, social and behavioral performance.

8. The number of deaths between 1 to 4 years per 1000 toddlers born is known as toddler mortality rate. The manifestations and effects of malnutrition are well known to be severe in toddlers.

9. Conditioning infections, cultural influences, socioeconomic factors, health and educational measures.

2.4 SUMMARY

The table drafted below gives an easy and valuable recap of all the methods of assessment.

Table 2.13 Summary of Methods of Assessment of Nutritional status

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Sources of information	Nature of information obtained	Nutritional implication
Agricultural data, Food balance studies	Gross estimates of agricultural production agricultural methods soil fertility, predominance of cash crops over production of staples, food import and exports	Approximate availability of food supplies to a population
Socioeconomic data, information on marketing distribution and storage	Purchasing power, distribution and storage of food stuffs	Unequal distribution of available foods between the socio-economic groups in the community and within the family.
Food consumption pattern, cultural anthropological data Dietary surveys	Lack of knowledge erroneous beliefs and prejudices in difference	Unbalanced nutrient intake
Special studies on foods	Food consumption, distribution within the family Biological value of diets, presence of interfering factors (goitrogens) effects of food processing	Low excessive or unbalanced nutrient intake
Vital health statistics	Morbidity and mortality data	Special problems related to nutrient utilization Extent of risk to community , identification of high risk group
Anthropometric studies	Physical development	Effect of nutrition on physical development

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Biochemical studies	Physical signs	Deviation from health due to malnutrition
Additional medical information	Levels of nutrients metabolites and other components of body tissues	Nutrient supplies in the body, impairment of biochemical functions in tissues and fluids
	Prevalent disease including infections	Inter - relationship between state of nutrition and disease

Source: B.Srilakshmi, Nutrition Science

2.5 KEY WORDS

- **Anthropometry:** study of physical dimensions, proportions and composition of human body.
- **Wasting:** Thinness or emaciation of body.
- **Stunting:** Decreased length
- **Clinical Assessment:** Visible changes in superficial epithelial tissues.

2.6 SELF ASSESSMENT QUESTIONS AND ANSWERS

Short Answer Questions

1. List the methods used to assess the nutritional status of a community.
2. What is BMI? How do you classify malnutrition using BMI?
3. Define a)IMR b) PNMR c)TMR

Long Answer Questions

1. Describe the anthropometric methods used to assess the nutritional status of the community.
2. Explain the clinical signs and how are they useful in examining the nutritional status.
3. Discuss the laboratory tests used for nutritional assessment.
4. Elaborate the indirect assessment methods and their significance in assessment of nutritional status

2.7 FURTHER READINGS

- Suryatapas, 2018, Textbook of Community Nutrition, 3rd Edition, Academic Publishers, West Bengal.
- Prabha Bisht, 2017, Community Nutrition in India, Star Publications, Agra.
- Srilakshmi.B, 2016, Nutrition Science, New Age International Publishers, New Delhi.
- Swaminathan.M, Essentials of Food and Nutrition, Bangalore Publishing Ltd. Bangalore.

*Direct and Indirect
Methods of Nutritional
Assessment*

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UNIT-3 PROTEIN ENERGY MALNUTRITION

Structure

- 3.0 Introduction
- 3.1 Objectives
- 3.2 Etiology
- 3.3 Prevalence
- 3.4 Theories of PEM
- 3.5 Different Forms and symptoms of PEM
 - 3.5.1 Kwashiorkor
 - 3.5.2 Marasmus
 - 3.5.3 Marasmic Kwashiorkor
 - 3.5.4 Nutritional Dwarfing or Stunting
 - 3.5.5 Underweight Children
- 3.6 Biochemical and Metabolic Change
- 3.7 Changes in Organs and Hormones
- 3.8 Treatment of PEM
- 3.9 Prevention of PEM
- 3.10 Answers to Check Your Progress Questions
- 3.11 Summary
- 3.12 Key Words
- 3.13 Self-Assessment Questions
- 3.14 Further Readings

3.0 INTRODUCTION

Throughout the globe, an envisioned 26 million children underneath the age of five are stricken by extreme acute malnutrition. This range is mind-blowing – most significantly, due to the fact kids with severe acute malnutrition are in instances much more likely to die than properly-nourished youngsters. Those deaths are the direct end result of malnutrition itself, as well as the oblique result of childhood illnesses like diarrhea and pneumonia that malnourished youngsters are too vulnerable to survive.

Severe acute malnutrition can boom dramatically in emergencies. However notwithstanding what we see within the headlines, the majority of instances occur in developing international locations now not stricken by emergencies. Those settings are plagued as a consequence of persistent poverty, lack of education, poor hygiene, restricted right to healthy diets.

A brief note on malnutrition have been given in Unit- 1 and Unit-2. We shall in detail discuss the important parameters of Protein Energy Malnutrition in this section.

3.1 OBJECTIVES

This unit will provide an insight to

- The different forms of Protein Energy Malnutrition
- The causes of Protein Energy Malnutrition
- Prevalence of Protein Energy Malnutrition
- Signs and Symptoms of Protein Energy Malnutrition
- Prevention and treatment of Protein Energy Malnutrition

We will first start with the causes of PEM and then go over to learn other aspects.

3.2 ETIOLOGY

The causes of PEM, an important man made nutritional disorder of public health significance can be clustered under maternal malnutrition, low birth weight, faulty feeding practices, dietary inadequacy, infections, low economic status and cultural practices.

Some of the important causes of PEM are detailed herewith:

- **LOW BIRTH WEIGHT:** The beginning of PEM in children starts in rural India from the time of birth. At least one third of the children are born with low birth weights (<2.5kgs) due to maternal malnutrition.
- **INADEQUATE BREAST FEEDING & DELAYED WEANING:** Another giant reason is insufficient breast milk fed to children, as the mothers nutritional status is also poor, which do not support sufficient secretion of milk. Moreover, the inadequacy of milk is not backed with weaning foods too. Delayed weaning further aggravates the dietary inadequacy leading to PEM that can be either due to ignorance, non-availability of foods, customary practices followed towards weaning.
- **DIETARY INADEQUACY:** Worldwide, the maximum not unusual reason of malnutrition is insufficient meals consumption. Preschool-aged kids in developing countries are regularly at chance for malnutrition due to their dependence on others for meals because of low purchasing power of the parents, large families, food taboos, increased protein and energy requirements, immature immune systems inflicting a greater susceptibility to contamination, and exposure to unhygienic situations.
- **ANOREXIA** - Anorexia in old age, because the lack of urge for food and/or reduced food intake in overdue life, is used to describe multifaceted scientific conditions which might be not unusual among frail older humans however no longer easily grouped into precise illnesses or syndrome categories.
- **INFECTIONS:** In young, the anorexia could be due to viral/ bacterial infections and parasitic infestations, leading to reduced food intake. Also, the infections cause frequent diarrhea and acute respiratory infections which leads to onset of PEM.

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- **CONTEMPORARY CAUSES OF PEM-** In developed international locations, insufficient meals consumption is a less usual reason of malnutrition than that due to decreased absorption or extraordinary metabolism. As a consequence, diseases, along with cystic fibrosis, chronic renal failure, adolescence malignancies, congenital heart sickness, and neuromuscular sicknesses contribute to malnutrition in developed countries. Fad diets, irrelevant control of meals allergic reactions, and psychiatric diseases (example, anorexia nervosa) also can lead to intense protein-energy malnutrition. Populations in each acute- and long-time period centers are at threat for clinically huge involuntary weight reduction (IWL) which could bring about protein-energy malnutrition. IWL is described as a loss of 4.5 kg or extra than 5% of the usual body weight over a duration of 6 months to one year. PEM happens when weight reduction of greater than 10% of normal body weight occurs.
Elderly sufferers are often at threat for protein-energy malnutrition due to insufficient vitamins, which has been decided to be a common comorbid thing for multiplied morbidity and mortality in geriatrics.
- **OTHER CAUSES -** Other causes of ensuing malnutrition include decreased appetite, dependency on help for eating, impaired cognition and/or communique, terrible positioning, frequent acute ailments with gastrointestinal losses, medicinal drugs that decrease appetite or increase nutrient losses, reduced thirst response, decreased capacity to pay attention to urinate, intentional fluid restrict because of worry of incontinence or choking if dysphagic, psychosocial factors which include isolation and melancholy, monotony of weight-reduction plan, better nutrient density necessities, and different needs of age, illness, and ailment.

3.3 PREVALENCE

The extent of any disease is measured in terms of prevalence rate, which indicates the number of individuals with a particular disease at a particular point of time in a specified number. PEM is still the most common nutritional disorder arising due to multi-deprivation and poverty. 98% of hungry people live in developing countries where almost about 12.97% of the population is under nourished. A global estimate of 26 million children under 5 years are severely malnourished. Under nutrition contributes to 2.6 million deaths of children under 5 years which marks one-third of the global total (UNICEF 2011). 1 out of 6 children in developing countries are under weight and 1 in 4 stunted children live in developing countries. As per NFHS-3 severely malnourished under 5 children in India are estimated to constitute 6.4% in addition to 19.8% who are moderately malnourished, this amounts to 8.1 million children with severe acute malnutrition in India. According to the Food Security and Nutrition in the world 2017 report 38.4% of children in India are stunted while 21% suffer wasting. In India, malnutrition contributes to 24% of under 5 deaths and

30% of neonatal deaths. Thus the problem of PEM in India is wide spread and requires immediate intervention.

3.4 THEORIES OF PEM

- ❖ **Theory of Adaptation** - In 1971, Gopalan proposed the principle of adaptation and dysadaptation to explain the medical phenotype in marasmus and kwashiorkor. He explained the genesis of edema to be due to the impaired hepatic function as a result of cortisol impairment, wherein a marasmic child is able to adapt itself to low calorie and protein diet by producing more cortisol, even though they were fed with similar diets.
- ❖ **Free radical theory** - Free oxygen radicals are doubtlessly toxic to cell membrane and are produced at some point of numerous infections. Those oxides are generally buffered via proteins and neutralized with the aid of antioxidants consisting of Vitamin A, C & E and Selenium. In malnourished child deficiency of these vitamins in the presence of contamination or aflatoxin may also result in the buildup of poisonous – unfastened oxygen radicals. These may additionally harm liver cells giving rise to Kwashiorkor.

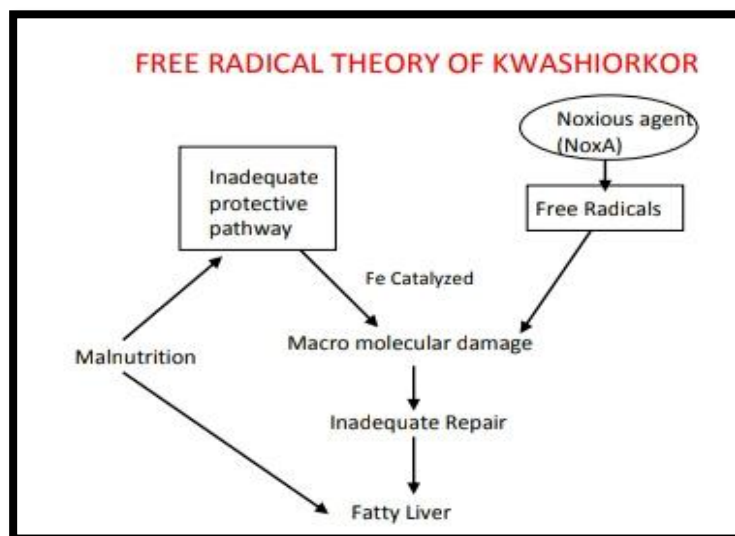


Figure 3.1

Check Your progress

1. Outline the causes of PEM.
2. Explain the theories of PEM.

3.5 DIFFERENT FORMS AND SYMPTOMS OF PEM

Protein Energy Malnutrition (PEM) is a form of malnutrition this is defined as various pathological conditions springing up from coincident

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lack of dietary protein and/or energy (energy) in varying proportions. The term Protein Energy Malnutrition applies to a set of related disorders that encompass kwashiorkor, marasmus and intermediate states of marasmus-kwashiorkor.

The word kwashiorkor, coined by Cicely D Williams in 1935, changed the view and portrayed that this word is taken from the Ga language of Ghana to suggest 'sickness of the deposed child while the second is born'. She described this scientific syndrome among youngsters residing at the Western coast of Africa, who had been weaned onto low-protein and starchy eating regimen (cooked plantain, candy potato and cassava), after being displaced from the breast with the aid of a younger sibling.

The term Kwashiorkor is defined as a childhood ailment as a result of protein deprivation. Early symptoms consist of apathy, drowsiness, and irritability. More superior symptoms are negative growth, lack of stamina, loss of muscle mass, swelling, extraordinary hair (sparse, skinny, frequently streaky purple or gray hair in darkish-skinned children), and strange pores and skin that darkens in unexposed regions. An enlarged and protuberant stomach is not unusual. Kwashiorkor disables the immune function, rendering the susceptible to a host of infectious diseases.

The definition of marasmus includes a situation of chronic undernourishment occurring specially in children and typically caused by a food regimen poor in calories and proteins. Research advocates that marasmus represents an adaptive reaction to starvation, while kwashiorkor represents a maladaptive reaction to starvation.

The symptoms and clinical features vary with the classification of PEM, are discussed in detail below.

3.5.1 Kwashiorkor

Kwashiorkor, additionally called "edematous malnutrition" because of its affiliation with edema (fluid retention), is a nutritional disorder most often visible in regions experiencing famine. It's a form of malnutrition because of a lack of protein in the diet. Children with kwashiorkor normally have a really emaciated appearance in all body components but their ankles, feet, and stomach, are edematous.

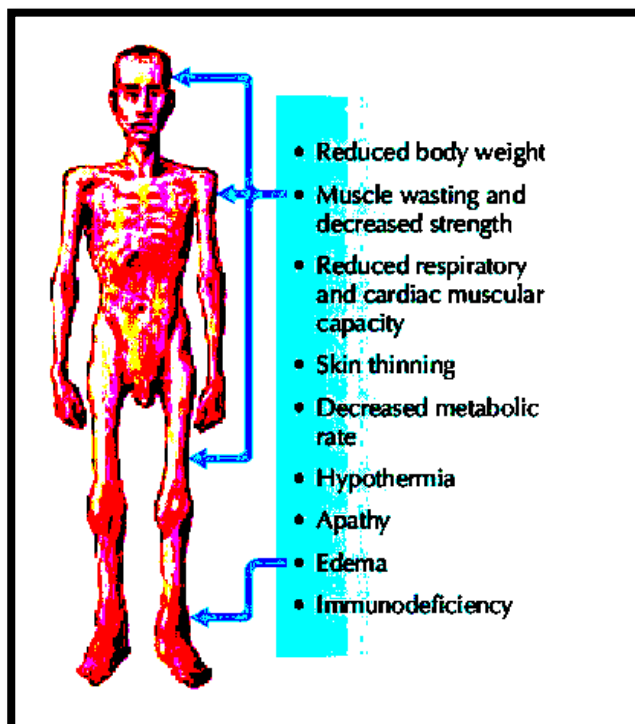


Figure 3.2 Common Signs and Symptoms of PEM

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Essential Signs and Symptoms of Kwashiorkor

- **Failure to grow or gain weight** in spite of water retention in the body and presence of subcutaneous fat in some children, primarily due to lack of protein.
- **Mental development** is affected. Psychomotor changes are evidenced by mental apathy in the form of restlessness, irritability, inertness, lack of interest etc.
- **Pitting edema** - Cutaneous edema is known as "pitting", appears on feet and legs initially and then spreads to whole body. Puffiness or oedema in face, also called as moon face, makes face look puffy with sagging cheeks and swollen eyelids. Oedema is also attributed to hypoalbuminemia, high levels of sodium and potassium in the serum, reduced levels of copper, Ceruloplasmin, Super oxide dismutase and decreased levels of antioxidants.
- **Fatty liver**

Non-Essential Signs and Symptoms

- **Patchy alopecia** - Change in hair color (to a rust color) and texture. Alopecia areata is a sickness that causes hair to fall out in small patches that may stay unnoticeable. This disease develops whilst the immune system attacks the hair follicles,

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ensuing in hair loss. **Flag Sign**, alternate light and dark discoloration band in hair is also seen.

- **Desquamation**- Scaly pigmentation of the skin. In severe cases the epithelium peels off leaving behind depigmented patches with oozing fluid which is described as **crazy pavement dermatitis**.
- **Diarrhea** – Diarrhea, the common symptoms of malnutrition, occurs in kwashiorkor due to malfunctioning of G.I. system or as a result of secondary infection.
- Damaged immune system that could lead to more frequent and extreme infections.
- Loss of teeth
- Nutrition deficiencies such as vitamin A deficiency which leads to Xerophthalmia and B-complex deficiencies with glossitis and angular stomatitis may be observed in PEM.

Having understood, the clinical signs and symptoms well, the figure below clearly portrays the pathways leading to fatty liver, an essential sign of kwashiorkor.

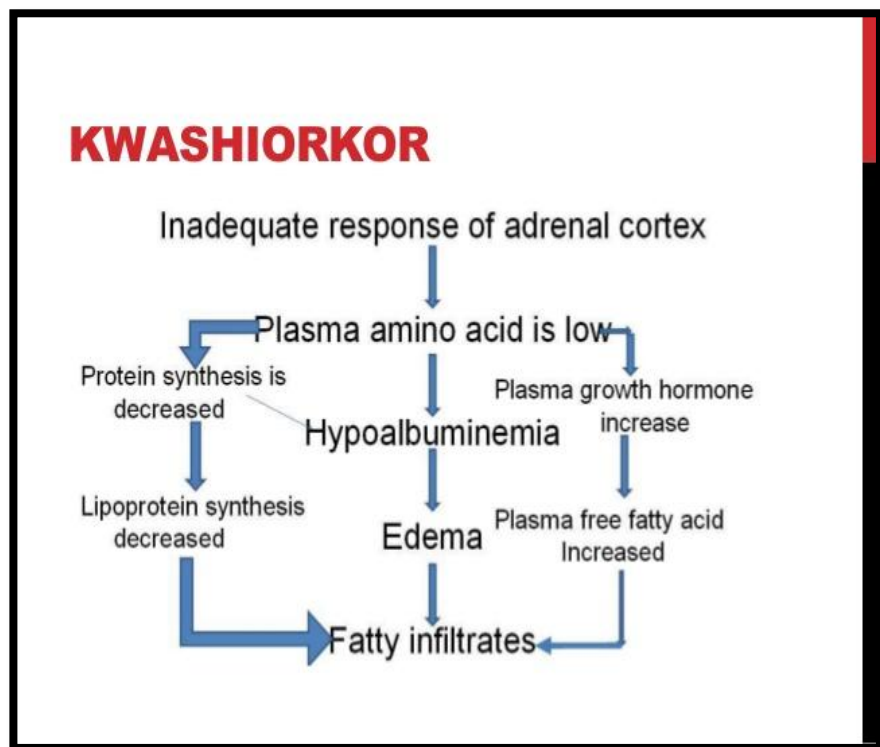


Figure 3.3 Pathogenesis of Fatty Liver in Kwashiorkor

3.5.2 Marasmus

The trauma of protein energy malnutrition and the secretion of cortisol affects the child that moves protein from muscle tissues to subcutaneous tissues to the amino acid pool which results in wasting of muscles without edema and also without hepatomegaly. Cortisol is a steroid hormone that regulates an extensive vital strategies of the whole body, which include metabolism and the immune response. It additionally has a very critical

function in supporting the body's response to stress.

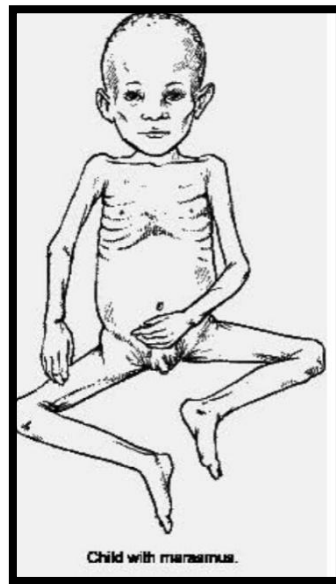


Figure 3.4 Marasmic Child

The signs and symptoms in marasmus include:

Essential Signs and Symptoms of Marasmus

- **Growth Retardation:** The child weighs below 60% of the standard weight.
- **Wasting of Muscle and Subcutaneous Fat:** Weak muscles, the limbs appears as skins and bones.
- **No edema**
- **Absence of Fatty Liver:** Due to better adaptation to stress, fatty liver is absent in marasmus.

Non-Essential Signs and Symptoms

- Hair changes not present
- Classical dermatitis not seen.
- Continual diarrhea, Steatorrhea may be seen.
- Belly shrinkage
- Wizen face- monkey face or face looks like an old man.
- Vitamin deficiencies
- Apathy and irritability
- Hungry always but at times anorexic.
- Subnormal body temperature

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3.5.3 Marasmic Kwashiorkor

Marasmic kwashiorkor is the third form of protein-energy malnutrition that combines features and signs of each marasmus and kwashiorkor. A child with marasmic kwashiorkor may additionally be extremely thin, show signs of wasting and have excessive fluid buildup in other body parts, have loose and hanging skin folds, old man or monkey face seen and is absolutely weak.

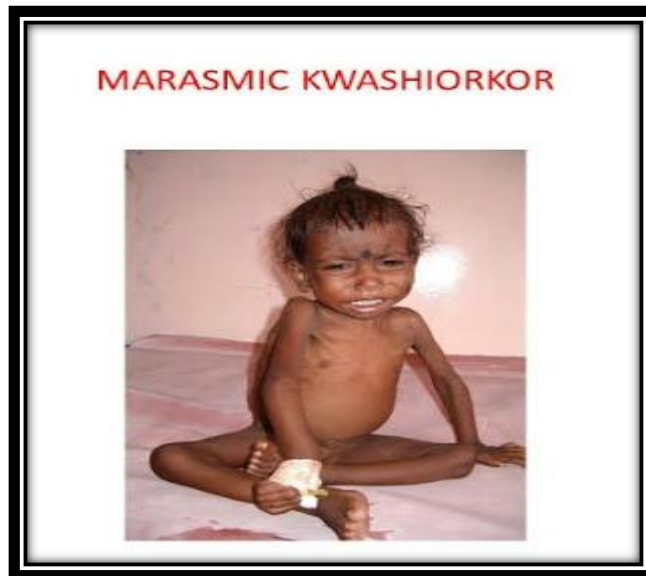


Figure 3.5 Marasmic Kwashiorkor

3.5.4 Nutritional Dwarfing or Stunting

Nutritional dwarfing refers to a condition, where chronic PEM starts in early years of life without proceeding to kwashiorkor or marasmus, but by a marked retardation of growth. The child adapts to prolonged insufficiency of food, showing poor linear growth and delayed pubertal development. The term bonasal children or pocket editions are now frequently used for this condition.

Beyond height, stunting can negatively affect a child’s brain characteristic, organ development, and immune function — limiting the future productiveness of the children, which is depicted in figure 3.6.



Figure 3.6 Costs of Stunting

3.5.5 Underweight Children

In underweight children weight for age is only 60-80% of the

expected weight. Children with subclinical PEM having reduced plasma albumin grow smaller than their genetic potential and are at the risk of gastroenteritis, respiratory and other infections which can precipitate frank malnutrition. Underweight also inhibits the cognitive development, and impacts fitness reputation later in existence.

Apart from this, several classification of malnutrition based on the anthropometric measurements has also been discussed under unit-2.

With a definite knowledge on the types of PEM, it is also important for us to learn about the different biochemical and metabolic changes so that the nutritional implications and nutritional interventions can be well understood.

Table 3.1 Characteristics of Kwashiorkor and Marasmus

Characteristics	Kwashiorkor	Marasmus
Definition	PEM primarily due to protein deficiency followed by calorie deficiency (More of Protein deficiency).	PEM due to both calorie and protein deficiency (More of Calorie deficiency).
Age	1 to 3 years	Any age, but infants commonly affected.
Weight loss	60-80%	<60%
Oedema	Present	Absent
Muscle wasting	Less	More
Mental Changes	More affected	Less affected
Hair Changes	Evident- thin, dry, sparse, patchy alopecia, discoloration, flag sign. Bulb and root of the hair are distorted.	Infrequent. Bulb and root of the hair are not distorted.
Skin changes	Scaly pigmentation, crazy pavement, dermatosis	Wrinkled skin
Heart	Micro/macro cardia/normal	Microcardia
Growth retardation	Less severe	More severe
Diarrhoea	Present	Not common
Complications	Severe	Moderate
Prognosis	Variable	Good
Mortality rate	High (33% approx.)	Moderate (20% approx.)
Hypoalbuminemia	+	-

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Electrolyte imbalance	+	+
Fatty liver	+	-
Abnormal fat metabolism	+	-
Low Vitamin A absorption	+	-
Protein depletion	+	+
Low body temperature	-	+
Blood urea	Lowered	Normal
Plasma glucose level	Lowered	Normal
Ration of EAA to Non-EAA	Lowered	Normal

Check Your progress

3. Define Kwashiorkor.

4. What are the different forms of PEM?

3.6BIOCHEMICAL AND METABOLIC CHANGES

The changes rely on the type and severity of PEM. Let us have a look at the various metabolic changes possible.

Protein Metabolism

- Considerable findings in kwashiorkor project hypoalbuminemia (10-20 g/L), while in marasmus the plasma albumin values are around 25g/L. Low albumin levels are related to oedema.
- Plasma immunoglobulin, IgG is raised if infections are present. Plasma Ceruloplasmin, transferrin and retinol binding protein are lowered causing edema, iron and vitamin A deficiency respectively, in kwashiorkor child.
- In kwashiorkor, cholinesterase, amylase and lipase levels are lowered but not altered in marasmus.
- Hepatic and pancreatic functions are maintained in positive manner in marasmic, than in kwashiorkor patients.
- In kwashiorkor, urinary excretion of hydroxyproline is reduced, reflecting impaired growth and wound restoration and reduced body collagen.
- Blood urea level lowers in kwashiorkor and may fall to 6mg/100ml.

Carbohydrate Metabolism

- Kwashiorkor children may develop hypoglycemia. Glucose tolerance may be impaired in some patients.

Lipid Metabolism

- Fatty liver is one of the clinical presentation of kwashiorkor, but it is not seen in marasmus.
- The level of free fatty acids in the plasma tend to be high, in all the types of PEM, due to partial starvation.
- Plasma triglyceride and plasma cholesterol level will be low in kwashiorkor, but not in marasmus.

Electrolyte and Water Metabolism

- Electrolytes, mainly potassium and magnesium, are depleted, due to diarrhea. Plasma potassium levels lowers to 2.5mmol/l in kwashiorkor.
- Plasma sodium levels are generally normal in both the conditions.
- The share of body water and extracellular water is increased in kwashiorkor.

3.7 CHANGES IN ORGANS AND SYSTEMS IN PEM

Digestive Organs: The activity of enzymes of digestion namely amylase, trypsin and lipase are reduced. Cells of pancreas and intestinal mucosa are atrophied leading to impaired nutrient absorption in all types of PEM.

Liver: Severe liver failure is unusual. Hepatomegaly, enlarged liver with fatty infiltrates is seen in kwashiorkor, where fat accumulates as small droplets within the liver cells, situated at the periphery of lobules and extends to centre of lobules.

Kidneys: Mild albuminuria is seen, also GFR is low due to dehydration and reduced cardiac output.

Cardiovascular system: Cardiomegaly, tachycardia and bradycardia are seen. Extremities are cold and cyanosed because of too much of carbon dioxide in blood.

Immunological system: If the PEM occurs in very young children, the system immune response is weak and hence easily susceptible to infections. Atrophy of thymus, spleen and other lymphoid tissues and reduced T cells in blood and lymphocytes are seen. Once, the immunological system is mature, it is less susceptible to malnutrition and infections.

Neurological system: The neurological disturbances manifest as mental confusion, psychomotor changes, hyper reflexia, spinal ataxia, sensory loss and nutritional neuropathies. The disturbances in CNS, depends on the age of the child affected. PEM in Pre-school years reduces glial cells, DNA, RNA, protein, total lipid, cholesterol, phospholipid, and myelin content of brain causing irreversible damage.

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Musculoskeletal system: Muscle wasting, calf tenderness, frontal and parietal bossing, craniotabes, beading of ribs, knock-knees or bow legs, epiphyseal enlargement and musculo skeletal haemorrhages are common manifestations in PEM children.

Hormonal Changes: PEM causes hormonal imbalances affecting the normal growth and development processes.

- Reduced muscle protein synthesis, decreased lipogenesis and reduced growth reduces the insulin activity.
- Increased visceral protein synthesis, lipolysis and decreased urea synthesis and glucose uptake by tissues increase the production of growth hormone.
- Reduced muscle and cartilage protein synthesis, collagen synthesis, growth and increase in growth hormone production, lipolysis, lowers the level of somatomedins (insulin-like growth factors).
- Lipolysis and glycogenolysis inhibits insulin secretion and impact the levels of epinephrine.
- Increase in muscle protein catabolism, visceral protein turnover, lipogenesis, gluconeogenesis and lowered levels of somatomedins in turn increase the levels of glucocorticoids.
- In kwashiorkor the levels of thyroid hormones are high owing to decrease in glucose oxidation, basal energy expenditure and increase in T3 levels.
- Menarche is delayed due to gonadotropin imbalance.

Table 3.2 Hormonal Changes in PEM

Hormonal Changes in PEM		
HORMONE	MARASMUS	KWASHIORKOR
GH	. N/ H	. VH
Glucocorticoids	. VH	. H
Insulin & IGF	. N/L	. L
Somatomedins	. L	. VL
Glucagon	. H	. VH
Thyroxin	N/ L	. N/ H

GH- Growth hormone, **H-** High, **VH-** Very high, **N-** Normal, **L-** Low.

3.8 TREATMENT OF PEM

Having discussed the types, signs and symptoms, the stratagem to overcome PEM does not end. The treatment comprises of three essential stages that can be overviewed in the following pages.

The stages are:

1. Hospital treatment: To resolve life threatening conditions. The hospital treatment involves following therapeutic measures.

Dehydration - Oral or nasogastric administration of fluids help to treat patients with mild to moderate dehydration. The oral rehydration salts (ORS) is also suggested for correcting dehydration. It is prepared by dissolving the listed salts in 1 liter of boiled and cooled drinking. The composition of the salts as recommended by WHO is as follows:

Sodium chloride (table salt) – 3.5 gram

Sodium bicarbonate (baking soda) – 2.5 gram

Potassium chloride – 1.5 gram

Glucose - 20 gram

Based on the severity of dehydration 70-100 ml ORS/ kg body weight can be given at frequent intervals for a period of 4-6 hours. A clean ORS must be made up every 12-24 hours. The pre-prepared solutions have to no longer be boiled.

In case of severe dehydration, I.V fluid therapy is required to improve circulation and expand plasma volume rapidly by administering 70-100ml of fluid in the first 3-4 hours, restored to ORS for maintenance after correcting the deficit of body fluid levels. Oral potassium supplements of 1-2g/kg/day ensure faster recovery. Globally, evidence on health benefits of zinc nutrition and zinc supplementation for the growth of stunted children and children with diarrhoea has been discovered in the last decade. WHO established that zinc supplements can reduce the duration of a diarrhoea episode by 25% and are associated with a 30% reduction in stool volume.

Infections: Whilst the causative agent of the contamination is known or suspected, the appropriate antibiotic therapy need to be used. Thus for common infections which includes pneumonia, otitis, tonsillitis penicillin is the drug of choice. Giardiasis and Ascariasis must be treated with appropriate deworming agents.

Hypoglycemia: 1mg of 50% dextrose solution/ kg body weight should be given intravenously. In mild cases, milk feed and glucose in water will help.

Anaemia: Blood transfusion is recommended if hemoglobin falls below 5g/dl. 10ml of packed cells/kg body weight administered slowly for 3 hours.

2. Dietary Management: To restore nutritional status without disrupting homeostasis.

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It is very well documented in the above sections that PEM is a purely nutritional disorder. Therefore, it becomes mandatory for us to know the nutritional requirements during PEM to decrease the convalescence period. Now, let us discuss the nutritional needs.

Dietary management plays a vital role in prevention, treatment or recovery from PEM. The principles of dietary management include

- Diet rich in calories and protein.
- An acceptable and easily digestible diet.
- Economic and readily available ingredients based homemade diet.
- **Energy** – For children above two years 150 to 200 kcal/kg body weight. For children below 2 years 200 kcal/kg body weight should be given. Malted cereals, banana, sugar and fat included in the diet helps achieve calorie intake.
- **Protein** – 5 gram of protein per kilogram of the existing body weight should be given. A cereal pulse combination of 5:1 ratio helps to meet calorie as well as protein requirement. Whole milk is not tolerated if diarrhea persists, in such conditions skimmed milk can be preferred. Bengal gram is a cheap and effective source of vegetable protein. A ratio of 3:1, vegetable and animal protein should be included in the diet.
- **Fats** –35 to 40 percent of the total calories can be tolerated from fat. Inclusion of 1 to 2 tsp of saturated fat sources like butter, ghee or coconut oil makes food palatable and helps to increase calorie intake without causing gastrointestinal disturbances.
- **Vitamins** – For those with vitamin A deficiency associated with PEM diagnosed, then oral dose of 50,000 IU of fat soluble vitamin A should be administered soon, followed by 5000 units daily. Intramuscular or intravenous injections of 2 to 5 mg of Vitamin K/ day for 2 to 3 days is advocated in severe PEM. Vitamin C and D should also be supplemented to prevent deficiencies.
- **Minerals** – 2.4 gram of potassium chloride and 0.5 gram of magnesium chloride can be added to the diet daily for the time period of two weeks. 300 mg of calcium lactate administered for 3 times a day enhance calcium levels. Ferrous sulphate salts improve levels of iron. Zinc and copper supplements should also be provided.
- **Fluid:** 100ml/kg/day of fluids are recommended to prevent dehydration.

3. Nutritional Rehabilitation: To ensure convalescence. Nutritional rehabilitation is carried out through three units' namely residential units, day care units and domiciliary units to avoid malnutrition relapses.

Residential Units, offer residence to mothers along with their child and under the guidance of nutritional demonstrators they work as a team and prepare suitable therapeutic diets with locally available foods and feed their children. One such therapeutic food is explained below.

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Ready to Use Therapeutic Foods (RUTF): Currently evolved home-based treatment for extreme acute malnutrition is enhancing the lives of thousands of kids below 12 months. Ready-to-use therapeutic food (RUTF) has revolutionized the remedy of intense malnutrition – providing meals which might be safe to apply at home and make certain speedy weight gain in critically malnourished children. The benefit of RUTF is that it's a ready-to-use paste which does not want to be blended with water, thereby heading off the risk of bacterial proliferation in case of unintentional contamination. The product, that is based on peanut butter combined with dried skimmed milk and vitamins and minerals, may be ate up immediately by the kid and offers enough nutrient consumption for complete recuperation. It could be saved for three to four months without refrigeration, even at tropical temperatures.

Also, sessions on feeding schedules help enlighten the mother on nutritional rehabilitation and promotes faster recovery.

Feeding schedule: When the child has been taking oral feeds well, he is ready to be placed on the high-energy feeding regime. Thus, on the 6th or 7th day he should be offered 150 ml of high-energy feed per kg of body weight per day. The higher the energy intake, the faster will be his rate of recovery. The calculated amount of high-energy milk feed is given, ideally, over 24 hours, in 6 feedings at 4-hour intervals. If it is not possible to feed the child every 4 hours, then the total amount of formula for the 24 hours should be given in 5 feeds. From the third week onwards, traditional foods should be progressively introduced into the diet of the child, gradually replacing the high-energy feed. This should ensure a smooth transition to normal eating. When older children are recovering from malnutrition, an entirely liquid diet is inappropriate and expensive. A mixed diet of high-energy foods with added oil should be given. Parents, or whoever takes care of the child, will be instructed to buy such foods and be taught how to prepare them at home in the residential units.

Day Care Units: The child attend the day care unit daily, while mothers are permitted one or two days per week, and learn the preparation and feeding techniques from the advisors. Delays the period of convalescence, as mothers take more time to learn about therapeutic foods and their importance.

Domiciliary units: Domiciliary units of nutritional rehabilitation is the home of the child. Nutritional demonstrators' visits home daily and managed personally at home.

Prevention is better than cure. So far we have discussed the treatment procedures to recover from PEM, now we shall study how to prevent PEM.

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Secondary PEM can occur in hospitalized patients due to decreased oral intake, increased nutrient losses and increased nutrient requirements, which may be influenced by socio economic factors and poor medical care.

3.9 PREVENTION OF PEM

The whole unit has depicted clearly that PEM is a consequence of interrelated factors like poor nutrition, unhygienic environment, poor living condition and lack of proper health care.

Family Goals to Prevent PEM

- Measures directed to pregnant and lactating women- educate on nutritious food, intake of oral supplements, and promotion of breastfeeding practices.
- Proper spacing between pregnancies.
- Improve quality of family diet.
- Development of low cost weaning foods.
- Hygienic and nutritious complementary feeding given at frequent intervals to the child.
- Safe vaccination

Community Goals to Prevent PEM

- Literacy level should be increased to avoid ignorance.
- Nutrition education by a trained nutritional educator.
- Growth should be monitored periodically.
- Family planning methods should be strictly implemented.
- The health package should be offered to people who are in poor economic status.
- Periodic surveillance.
- Early diagnosis and treatment of infections and diarrhea.

National Goals to Prevent PEM

- Mass fortification and enrichment of common foods to alleviate micronutrient deficiencies.
- Promoting Food Security
- Periodic deworming schedules should be implemented.
- Nutrition surveillance, which means periodic checking of the health problems that commonly affects and the way to tackle it.
- Nutritional planning, which means the policy designing and implementing that relates to health and nutrition.
- Economic status can be improved to increase purchasing power.
- Supplementary feeding program should be implemented during epidemics.

In nut shell, the comprehensive strategy known as NIMFES approach

helps in preventing PEM.

N: Nutrition

I: Immunisation

M: Medical care

F: Family planning

E: Education on health & nutrition

S: Stimulation

Also, UNICEFs measure to prevent PEM include GOBI project which focus on

G: Growth monitoring

O: Oral rehydration therapy

B: Breast feeding promotion

I: Immunization.

ICDS also plays a pivotal role in prevention of PEM by its several programme components like health monitoring, nutrition education, supplementary feeding, immunization etc.

Check Your Progress

5. Explain the principles in treatment of PEM.

6. What are the measures to be taken to prevent PEM?

3.10 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

1. Low birth weight, inadequate breast feeding, delayed weaning, dietary inadequacy, anorexia, infections, old age, weight reduction practices.

2. **Theory of Adaptation** - In 1971, Gopalan proposed the principle of adaptation and dysadaptation to explain the medical phenotype in marasmus and kwashiorkor. He explained the genesis of edema to be due to the impaired hepatic function as a result of cortisol impairment, wherein a marasmic child is able to adapt itself to low calorie and protein diet by producing more cortisol, even though they were fed with similar diets. **Free radical theory** - Free oxygen radicals are doubtlessly toxic to cell membrane and are produced at some point of numerous infections. Those oxides are generally buffered via proteins and neutralized with the aid of antioxidants consisting of Vitamin A, C & E and Selenium. In malnourished child deficiency of these vitamins in the presence of contamination or aflatoxin may also result in the buildup of poisonous – unfastened oxygen radicals. These may additionally harm liver cells giving rise to Kwashiorkor.

3. The term Kwashiorkor is defined as childhood ailment as a result of protein deprivation. Early symptoms consist of apathy, drowsiness, and irritability.

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4. Kwashiorkor, marasmus, marasmic-kwashiorkor, nutritional dwarfing or stunting and underweight are the different forms of PEM.
5. Hospital treatment, Dietary management and Nutritional rehabilitation.
6. Educate on nutritious food, intake of oral supplements, and promotion of breastfeeding practices, promote awareness on family planning, development of low cost weaning foods, hygienic and nutritious complementary feeding given at frequent intervals to the child, safe vaccination and immunization.

3.11 SUMMARY

We are now aware that Protein Energy Malnutrition is an important macronutrient deficiency disorder which has many implications on health and economy. PEM is a spectrum of disease arising from inadequate diet or nutrients. With proper education on nutrition and sanitation, PEM is a completely preventable disorder.

3.12 KEY WORDS

- **Kwashiorkor:** Malnutrition due to lack of protein.
- **Marasmus:** Malnutrition due to calorie or protein deficiency.
- **Oedema:** Fluid accumulation or retention.

3.13 SELF ASSESSMENT QUESTIONS

Short Answer Questions

1. Write a short note on dietary management of PEM.
2. What causes oedema in PEM?
3. How do you classify PEM based on weight for age?

Long Answer Questions

1. Differentiate kwashiorkor and marasmus.
2. Summarize the biochemical and metabolic changes in PEM.

3.14 FURTHER READINGS

- www.who.org
- Suryatapas, 2018, Textbook of Community Nutrition, 3rd Edition, Academic Publishers, West Bengal.
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UNIT-4 ECOLOGY OF MALNUTRITION

NOTES**Structure**

- 4.0 Introduction
- 4.1 Objectives
- 4.2 Ecology of Malnutrition
- 4.3 Nutrition and Infection
 - 4.3.1 Immunity
 - 4.3.2 Infections pertinent to poor nutrition
 - 4.3.3 Impact of Infection on Nutrients and Nutritional Status
- 4.4 Vicious Cycle of Malnutrition and Infection
- 4.5 Nutritional Disorders
 - 4.5.1 Iron Deficiency Anemia
 - 4.5.2 Vitamin A Deficiency
 - 4.5.3 Iodine Deficiency Disorder
- 4.6 Answers to Check your Progress Questions
- 4.7 Summary
- 4.8 Key Words
- 4.9 Self-Assessment Questions
- 4.10 Further Readings

4.0 INTRODUCTION

As we have discussed in our earlier units, malnutrition is not a single entity, it encompasses several factors like infection, starvation, poverty, overeating, environmental sanitation etc. and may also can occur as a result of improper digestion, metabolization or utilization of nutrients, even though it is available from food. Humans require a balanced diet to lead a quality and productive life. Malnutrition remains a huge worldwide trouble, and hampers the life of many individuals especially in growing countries.

4.1 OBJECTIVES

After studying this unit, you should be able to:

- Correlate the role of infection in malnutrition and vice versa.
- Explain the causes, symptoms and treatment of anaemia.
- Enumerate the functions of Vitamin A and consequences of Vitamin A deficiency.
- Understand the significance of iodine in growth and development and prevention of IDD.

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4.2 ECOLOGY OF MALNUTRITION

The ecology of malnutrition pertains to the relationship or cycle of food production, food supply, topography, demography and nutrition. The current scenario projects increase in population and food shortage arising as a result of it, as the major contributing factors to malnutrition.

The determinants of malnutrition can be placed at three different levels namely immediate cause existing at individual level-Inadequate dietary intake, diseases/ infections, underlying causes prevailing at household level – insufficient access to food, inadequate health care facilities, poor sanitation and lack of clean water, inappropriate knowledge on efficient usage of available resources and basic causes present at societal level are quantity and quality of human and food resources, political, cultural, religious, economic and social influences on food availability and environment, food production and storage technology.

Thus, the study of these determinants, project that to battle malnutrition an interdependence of matters on agriculture, industry, education, health, economic policies and research is essential. The impact of unfertile land, famine, drought, forced migrations lead to food scarcity. Post-harvest losses of food also contribute to the ecological causes of malnutrition.

The integrated approach that is required to combat malnutrition is in detail deliberated in unit 4.

Let us now study the interrelationship of nutrition and infection.

4.3 NUTRITION AND INFECTION

It is of consideration to know about immunity to understand the concept of nutrition and infection, as it is a chain, lack of immunity that clues to infections.

4.3.1 Immunity

Immunity, is defined as the capacity or ability of the human body to resist the toxins or organisms that tend to damage the tissues and organs. **Immunity**, in simple terms means being protected from something and being unaffected or not troubled by a foreign body. There are two principal types of immunity: innate or natural immunity and acquired, inherited or adaptive immunity.

Innate or Natural Immunity:Immunity with which an individual is born is called innate or natural immunity.Innate immunity is the first line of defense towards pathogens.Innate immunity is provided by various components such as Skin, mucus membrane, Phagocytic cells (Neutrophils, macrophages, and dendritic cells) through the mechanism of phagocytosis-The process by which phagocytes ingest or engulf other cells or particles which are foreign to the host.

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Acquired or Adaptive Immunity: Adaptive immune response is the second line of defense against non-self-pathogens. Adaptive immunity is also referred to as acquired immunity or specific immunity and is only found in vertebrates. Adaptive immunity works slower than innate, and is specific. The adaptive immune response is specific to the pathogen presented. The adaptive immune response is meant to attack non-self-pathogens but can sometimes make errors and attack itself. When this happens, autoimmune diseases can develop (e.g., lupus, rheumatoid arthritis). Acquired immunity is of two types viz: Humoral or B cell immunity, the body develops circulating antibodies which are globulin molecules that are capable of attacking the invading agent. In cell mediated or T cell immunity, large number of activated T lymphocytes that are specifically designed to destroy the foreign material are formed. Table 4.1 lists the difference between innate and acquired immunity.

Table 4.1: Difference between Innate and Acquired Immunity

Type of Immunity	Line of Defence & Timeline	Cells	Antigen Dependency	Examples
Innate (non-specific)	1 st line - Immediate response (0 -96 hours)	Natural killer cells, macrophages, neutrophils, dendritic cells, mast cells, basophils, Eosinophil	Independent	Skin, hair, cough, mucous membrane phagocytes, granulocyte
Adaptive (specific)	2 nd line - Long term (>96 hours)	T and B lymphocytes	Dependent	Pus, swelling, redness, pain, T and B lymphocyte response

4.3.2 Infections pertinent to poor nutrition

Although at times in certain individuals poor immunity is inherited by birth or some suffer from autoimmune disorders, for majority of the population immunity can be improved by healthy nutritious food, maintaining standards of personal hygiene and sanitary environment. The strong relationship between malnutrition and infection was originally described by Scrimshaw et al. From this framework, much investigation was done in this area and there is a total agreement among authors that mortality is

significantly more elevated in undernourished child compared to healthy ones.

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The following figure and paragraph presents you an understanding on nutritionally relevant infections and infestations.

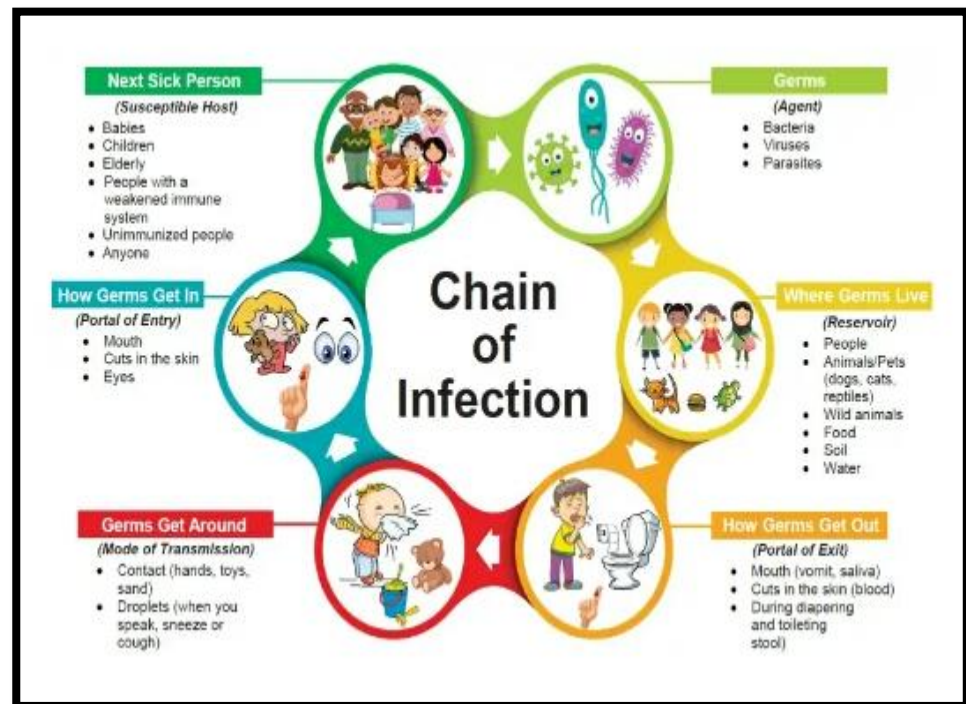


Figure 4.1 Chain of Infection

Bacterial Infection: A bacterial contamination is a proliferation of a harmful strain of bacteria on or within the body. One-third of the world's population is infected with *Mycobacterium tuberculosis*, the main agent that provokes death among infectious diseases, causing tuberculosis. This infection is particularly influenced by under nutrition and often co-exists with PEM. Gastroenteritis is another example of bacterial infection which causes high mortality among malnourished infants and preschool children causing inflammation of the stomach and persistent vomiting and diarrhoea, and weanling diarrhoea common among weaned malnourished infants can be cited to associate the relationship between nutritional status and incidence of infection. Pneumonia, meningitis, and food poisoning are also a few illnesses that can be resulting from dangerous bacteria. Noma is an opportunistic infection promoted by extreme poverty that evolves rapidly from a gingival inflammation to mutilating orofacial gangrene, as a result of very complex interactions among malnutrition, infection and compromised immunity. *Fusobacterium necrophorum* and *Prevotella intermedia* are the bacterial pathogens causing noma.

Bacterial infections decreases the absorption of nitrogen and increases excretion of nitrogen in urine and disposes to secondary anorexia. Thus, in such infections, the need for protein and other nutrients increases, else

diarrhoea instigated as an acute infection end as chronic diarrhoea.

Viral Infection: Infection resulting from the presence of a pandemic in the body due to virus. Depending on the state of health, numerous viruses can infect nearly any form of body tissue, from the brain to the skin. Examples include children with PEM suffers from influenza and measles. Even though effective vaccines are licensed for measles, it continues to cause death and severe disease in children worldwide. Complications from this viral infection can occur in almost every organ or system.

Parasitic Infection: A parasitic ailment, referred to parasitic diseases can have an effect on nearly all living organisms, with low immune stature. Malarial parasites cause hemolytic anaemia and deplete protein reserves. Hookworm infestation causes blood loss leading to anaemia. Ascariasis, small intestine infection is another example instigated by *Ascaris lumbricoides*, which is a species of roundworm prevalent in areas of poor sanitation and hygiene that interferes with absorption of nutrients in children. The coexistence between under nutrition and nematode infection encompasses two connecting trails, malnutrition that augments susceptibility to infection and the infection itself that leads to a more accentuated under nutrition. Intestinal nematodes provoke malnutrition causing anorexia and a variety of pathophysiological disturbances in the gastrointestinal tract such as vomiting, diarrhea and malabsorption. All these put together, affect the ability of the child to acquire sufficient nutrients from the diet. Parasites namely helminths, *Giardia duodenalis*, *Entamoeba histolytica*, coccidia and *Schistosoma* sp. that affect the nutritional status of the children, incite if the host is weak and the environment is unhygienic are mostly transmitted through soil.

4.3.3 Impact of Infection on Nutrients and Nutritional Status

The vicious cycle of infection and malnutrition also poses threat to the nutritional status of the malnourished individual through physiological and anatomical changes, subsequently arising the need for discussion on the status of each nutrient. The succeeding facts will highlight the impact of infection on nutrients and vice versa.

Carbohydrates: The most primitive sign of infection is anorexia and intolerance to food. The incidence of fever increases the Basal Metabolic Rate, which in turn increases the need for calories, but continuous under feeding (anorexia or unavailability of food) and low glycogen stores in liver headway to low levels of blood glucose.

Proteins: A sequence of diarrhoeal diseases, protein deficit diet, catabolism of tissue proteins and increased urinary nitrogen roots to negative nitrogen balance. This triggers the outbreak of PEM such as kwashiorkor or marasmus in three to four weeks.

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Consecutively, the immunological functions are impaired. As discussed in unit- 3, the atrophy of thymus, lymph nodes and spleen reduces the number and functions of T lymphocytes. Humoral immunity is spared, however cellular immunity is impaired, that is apparent by a decrease in delayed cutaneous hypersensitivity reactions. Further, there is reduction in, production of interleukin -1, interleukin -2 and gamma interferon, helper T-cells, serum thymic factor, antibody affinity, impaired secretory Ig A antibody response and phagocytic dysfunction. Thus infections, protein deficiency and immune competence act synergistically.

Fats: While infected, the liver fat and fat content of faeces (Steatorrhea) are high. Diarrhoeal infections decrease the absorption of fat.

Vitamins:

Retinol is involved in the proliferation of normal B and T cells and also the major site of vitamin A action is the T –helper cell. Thereby in vitamin A deficiency the humoral response or B cell immunity to bacterial, viral and parasitic infections, cell mediated or T cell immunity, mucosal immunity, natural killer cell activity and phagocytosis in brief, the entire protective mechanism is impaired. Also, the levels of serum vitamin A and carotene are reduced in severe infections – pneumonia, tuberculosis, rheumatic fever. PEM adds on to the infections in increasing the severity of deficiency causing xerophthalmia and keratomalacia, if sufficient supplements of vitamin A is not given. Thus, Vitamin A is rightly called “Anti-infective vitamin” as its deficiency decreases immuno-competence, showed by the reduction in number and function of T cells and suppressed production of antibodies by B cells.

Vitamin D is associated with the immuno haematopoietic activity. Thus in children with rickets and frequent infections, vitamin D deficiency leads to impaired neutrophil phagocytosis, anaemia and decreased bone marrow cellularity. Pneumonia, whooping cough may aggravate rickets.

Vitamin B complex: Infection affects thiamine metabolism precipitating beriberi. Trial studies have proved that infections have an effect on other B-complex vitamins such as B3, B6, B12 and folic acid. Anaemia occurs as a consequence of B6, B12 and folic acid deficiencies, also cell mediated immunity and antibody responses are impaired.

Vitamin C: Vitamin C deficiency affects immune system modulators such as blood histamine, serum complement, prostacyclin and B and T cell nucleotides and also immune functions such as neutrophil chemotaxis, lymphocyte proliferation, and antimicrobial and natural killer cell activities are hampered.

It is well established that the infectious diseases worsen vitamin C nutriture and delays reclamation. Infections like malaria, influenza and tuberculosis decreased blood concentrations of vitamin C and increased urinary

excretion.

Minerals:

Iron deficiency increases the incidence of infection by impairing lymphocyte and neutrophil function due to the deficiency of myeloperoxidase and ribonucleotidyl reductase, while impairing the lymphocyte response to antigen.

Infection like hookworm infestation and malarial haemolysis influences iron metabolism through blood loss resulting in anaemia of infection by interfering with iron binding capacity and shortening RBC life span.

Zinc plays a pivotal role in immuno-competence. As in any infection and PEM, zinc deficiency causes atrophy of lymphoid tissues and reduced activity of cellular and humoral cells. Normal immune system development is hindered if zinc is deprived in foetal or early post natal stages.

Calcium and Phosphorus: Loss occurs in tuberculosis. Diarrhoeal infections like cholera, gastroenteritis cause electrolyte imbalance owing to loss of sodium, potassium, chloride and phosphate eventually causing dehydration followed by circulatory collapse. Hence rehydration and restoration of electrolyte balance is crucial.

Apart from the nutrients, infections alter the activity of essential enzymes causing poor digestion and decreased nutrient absorption as in kwashiorkor. Whatever may be the cycle, infection to deficiency or deficiency to infection, the food intake is highly reduced, nutrient absorption is reduced hindering the normal physical as well mental growth and development process in children.

4.4 VICIOUS CYCLE OF MALNUTRITION AND INFECTION

Thus having learnt of infection, nutrients and nutritional status the figure 4.2 widens our insights into the vicious cycle of malnutrition and infection.

The pathological effects of infection are reduced ability to respond to metabolic and environmental changes which curtails the inflammatory and immune response and breeds chronic infections ubiquitous. The lack of gut motility with intestinal stasis, achlorhydria, reduction in Ig A and bile salts cause proliferation of harmful microbes which again damage the intestine, deconjugate bile salts and intensify malabsorption. If not suppressed, abdominal swelling due to persistent diarrhoea, small bowel overgrowth, gas formed, and intestinal stasis arises, which in turn cause specific nutrient deficiencies. The magnitude of infection, small bowel overgrowth, malabsorption, nutrient loss and stress in adapting to malnutrition intensify

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anorexia and reduce food intake further and thus is a cycle. Failure to treat, further reduces food intake increases physiological complications proving fatal.

Aggressive management of infection and malnutrition through effective immunization, encouragement of breast feeding, socio economic development, ensuring food and nutrition security successfully dissects malnutrition-infection conjugate pair.

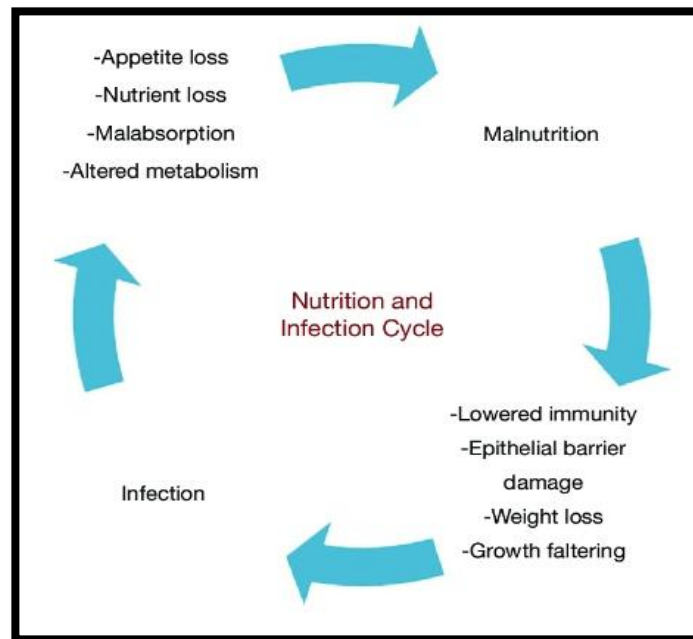


Figure 4.2: Vicious cycle of Malnutrition and Infection

With a wider understanding of macronutrient malnutrition ie. PEM, now let us move on to the micro nutrient disorders – vitamin and mineral deficiencies.

Check Your Progress

1. Define immunity and explain its types.
2. Describe the infections caused due to poor nutritional status.

4.5 NUTRITIONAL DISORDERS

Micronutrients although required in minimal amounts, they largely contribute to maintain normal metabolism and functions. Micronutrients are also called as super nutrients as their deficiency causes dreaded ill effects at a large scale. Of all the micronutrient deficiencies, iron, Vitamin A and Iodine deficiency contributes to higher percentages of morbidity and mortality. Hence, we shall discuss each one of them in detail.

4.5.1 Iron Deficiency Anaemia

Lerney in 1713, found iron as the constituent of body. In 1800, Lecanu

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recognized iron in the metalloprotein hemoglobin. Overall, 2.5 to 4 grams of iron is present in our body. Nutritional anaemia occurs as a result of the inability of erythropoietic cells to maintain normal hemoglobin status, on account of inadequate supply of one or more nutrients leading to fall in total hemoglobin production and circulation. Iron deficiency anaemia is a major global health problem affecting more people than any other condition, constituting a public health challenge of epidemic proportion. Anaemia with major consequences on health and well-being in women increases the risk of maternal and neonatal adverse outcomes. Other causes of anaemia may include vitamin B6, B12 and folic acid.

Epidemiology

The different cut-off levels of hemoglobin devised by WHO helps in determining the severity of anemia in individual. These values are dependent on age, sex and physiological status. It is also a known fact that men are little affected, while children and women of child bearing ages are most vulnerable groups.

Table 4.2 WHO Hemoglobin Cut-off Criteria for Anaemia

Age group	No Anaemia	Mild anaemia	Moderate anaemia	Severe anaemia
Children 6-59 months	≥11	10-10.9	7-9.9	<7
Children 5-11 years	≥11.5	11-11.4	8-10.9	<8
Children 12-14 years	≥12	11-11.9	8-10.9	<8
Non-pregnant women (15 yrs of age and above)	≥12	11-11.9	8-10.9	<8
Pregnant women	≥11	10-10.9	7-9.9	<7
Men	≥13	11-12.9	8-10.9	<8

Source: Haemoglobin concentration for the diagnosis of anaemia and assessment of severity. WHO

A 2011 WHO study estimated global anaemia prevalence to be 496 million of non-pregnant women and 32.4 million of pregnant women aged 15 - 49 years. It is estimated that half a billion women of reproductive age worldwide are affected by anaemia causing almost twenty percent maternal death directly. According to the reports of World Health Organization, Global Health Observatory Data Repository/World Health Statistics as of 2016, in India, prevalence of anaemia among non-pregnant women of reproductive age (15-49 years) was 51.50 % among pregnant women was 50.10% and among children (under 5) was 57.30%.

Etiology

The causes of anaemia include genetic, dietary or nutritional factors and other physical ailments. Let us learn about them in detail.

Genetic aetiologies include the following:

- Hemoglobinopathies
- Thalassemia

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- Enzyme abnormalities of the glycolytic pathway
- Defects of the RBC cytoskeleton – sickle cell anaemia
- Congenital dyserythropoietic anaemia
- Rh_{null} disease
- Hereditary xerocytosis
- Abetalipoproteinemia
- Fanconi anaemia

Nutritional factors include the following:

Inadequate Dietary Intake: The habitual cereal – legume based diet, even though contains adequate amount of iron, the availability of iron from this diet is only from 3 to 5%, proving a precipitating factor for iron deficiency anaemia. Also, good mineral diet is also a decent source of tannins and phytates which interfere with the iron absorption to a significant extent. The chemically determined iron content of Indian diet is 15mg / 1000 calories, but the availability is merely around 70%, providing only 10mg/1000 calories, which is sufficient to meet the RDA of men and pre-schoolers, provided their dietary intake meets the energy requirements. However, the vulnerable groups, women of reproductive age are susceptible for anaemia hence their diet should be enriched with heme iron from non-vegetarian sources or supplemental iron should be provided.

Inadequate Absorption and Utilization: Chronic gastrointestinal disturbances, defective release of iron from iron stores into plasma and poor iron utilisation due to inflammation can also cause anaemia. Gastrectomy impairs iron absorption because of achlorhydria and decreased transit time through the duodenum.

Infections: As discussed earlier in this chapter, hookworm infection, Tuberculosis, diarrhoea and PEM are causative factors for anaemia to occur.

Causative Factors in women: Excessive blood loss during menstruation, child birth, repeated and closely spaced pregnancies, prolonged lactation deplete iron store in women causing anaemia.

Increased Demand: Life stages of increased demands like infancy, where the blood volume rapidly expands, adolescence-rapid growth and onset of puberty in girls' anaemia is common, if the demand is not met.

Decreased Stores: Pre term, Pre mature babies, twins may have decreased iron stores and are susceptible for anaemia.

Socio Economic Factors: Poverty and ignorance are contributing factors for any deficiency diseases. Despite the fact, that locally available inexpensive foods like green leafy vegetables are good sources of iron, bioavailability is more only in expensive animal foods. Ignorance issues like consumption of tea or any tannin or phytates rich foods that interfere with iron absorption, along with an iron rich food also leads to anaemia.

Symptoms

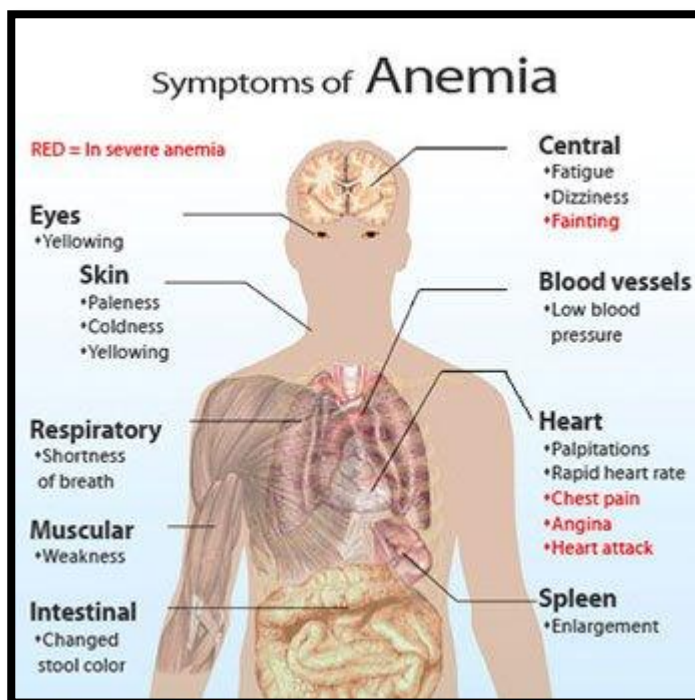


Figure 4.3: Signs and Symptoms of Anaemia.

Common signs and symptoms include fatigue, weakness, pale or yellowish skin, irregular heartbeats, shortness of breath, dizziness, cold hands and feet, headache, insomnia and dimness of vision.

The clinical findings observed include:

- **Decreased Immunocompetence:** Reduced T cells and antibodies in iron deficiency increases the susceptibility to infection.
- **Diminished Work Performance:** The person gets tired easily due to defective electron transport and cellular respiration.
- **Impaired Cognitive Development:** Iron deficiency in early years leads to irreversible brain damage. In later years, iron deficiency affects attention span, alertness and academic performance.
- **Behavioural Implications:** Anaemic children show disruptive, restless and irritable behaviour. Pica is common. Temper tantrum and breath holding spells are also commonly observed in children.
- **Skin and Epithelial Changes:** Alopecia, greying of hair, folliculitis, skin, and inside of lower eyelid look pale. Nail shows

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reduced growth, looks pale, thin and flat and koilonychia –spoon shaped nails develop eventually. Mouth changes include atrophy of lingual papillae and glossitis. Angular stomatitis and dysphagia is also seen.

- **Maternal and Perinatal mortality:** Increased risk of maternal and perinatal mortality is a consequence of iron deficiency anaemia. Also maternal anaemia contributes to pre mature births and low birth weight infants.

Diagnosis

Haemoglobin status is a diagnostic tool for iron deficiency. In certain conditions like, to identify deficiency at earlier stages, to distinguish between iron deficiency and other causes of anaemia, haemoglobin itself cannot prove a reliable tool. In such cases, different measurements are done for the evaluation of iron deficiency as follows, Iron stores can be measured by the serum ferritin level.

- Iron supply to the tissues can be evaluated by transferrin saturation level.
- Hemoglobin and hematocrit measurements are also indicates anemia.
- The ratio of zinc protoporphyrin to heme is an important indicator of iron supply to RBC formation.

Table 4.3: Indicators of Iron Deficiency

Indicator	Interpretable Guidelines
Peripheral smear	Microcytic hypochromic
MCHC (picogram)	<30
Serum Iron mcg/dl	<60
Total Iron Binding Capacity	>300
Transferrin saturation %	<15
Erythrocyte Protoporphyrin	>100
Protoporphyrin Heme Ratio	>32
Serum Ferritin mg/l	<12
Bone Marrow Iron	0 or +

Source: Textbook of Human Nutrition, Bamji. M.S. et al.

Treatment

Oral supplements of inorganic iron in the form of ferrous like ferrous sulphate 50 to 200 mg (that is, 60 mg elemental iron) three times a day for adults and 6mg per kilogram body weight of children should be administered. Ferrous forms of lactate, fumarate, glycine, sulphate, glutamate can also be used as iron supplements. Use of chelated form of iron improves absorption and reduces the likelihood of G.I distress. Vitamin C greatly increases iron absorption as it maintains iron in the reduced state.

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When dietary folate is also low iron alone is not sufficient for the production of RBCs, hence supply of folate is also essential. An improvement in riboflavin status may help better iron absorption. In severe cases (less to 5-7 grams per 100ml) blood transfusion becomes necessary. Table 4.4 indicates the RDA of iron to prevent anaemia.

Table 4.4 Recommended Dietary Allowances of Iron

Group	Iron mg/day
Man	17
Women	21
Pregnancy	35
Lactating	25
Infants	
6-12 months	5
Children	
1-3 years	9
4-6 years	13
7-9 years	16
Boys	
10-12 years	21
13-15 years	32
16-17 years	28
Girls	
10-12 years	27
13-15 years	27
16-17 years	26

Source: ICMR, 2010

Food Sources:

Haeme iron-liver, red meat like beef and lamb.

Non-haeme iron-cereals, millets like bajra and ragi, pulses and Green Leafy Vegetables.

Haeme iron is better absorbed than non-haeme iron.

Prevention: Food based approaches should be primary concern to combat any micronutrient deficiency.

Dietary Improvement: Food sources of haeme iron such as meat and flesh foods (organ meat) are better absorbed than non-haeme iron derived from cereals, pulses, fruits and vegetables. Consumption of vitamin C along with non-haeme iron enhances absorption of iron from the diet. Avoid drinking tea or coffee along with meals as it reduces the absorption of iron. Sprouted pulses increases bio availability of iron, vitamin C content, B complex

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vitamins favouring increase in haemoglobin levels. Inclusion of green leafy vegetables in the diets of infants and pre-school children also help to alleviate iron deficiency anaemia.

Supplementation: Children 6 to 24 months old are given 20mg of elemental iron and 100mcg of folic acid, adolescent girls on attaining menarche are given weekly dosage of one Iron Folic Acid tablet containing 100mg elemental iron and 500mcg of folic acid under Reproductive and Child Health Program. All pregnant mothers are given 60mg of elemental iron and 500mcg of folic acid for 100 days after the first trimester of pregnancy under the National Nutritional Anaemia Control Program.

Fortification: Fortification is one of the practical successful approach for preventing micro nutrient deficiencies. Salt, wheat flour, rice, sugar, milk fortification with iron has been successfully tried. Infant weaning foods are also fortified with iron. Fortification of rice with iron for use in midday meal program may prove effective to prevent iron deficiency among children.

Education: Nutrition education on home gardening and horticulture strategies to cultivate iron rich food sources provides cost effective approach to prevent anaemia. Creation of awareness in mothers about the relationship between diet and disease, hygienic practices will also help to combat anaemia. Discouraging the consumption of foods and beverages that inhibit iron absorption should be made known. Awareness on immunisation is a must.

Thus, multi strategy approach-dietary, supplementation, fortification and education will be successful in preventing anaemia.

Check Your Progress

What is anaemia? List the food sources to prevent anaemia.

Explain the causes of iron deficiency anaemia.

4.5.2 Vitamin A Deficiency

We know that Vitamins cannot be synthesised in the body and hence it becomes essential to supply them through diet, failure of which leads to deficiency conditions. Vitamins are organic accessory food factors necessary for normal metabolic functions. Vitamins are classified as fat soluble and water soluble. Vitamin A, D, E, K are fat soluble and B-complex group of vitamins and vitamin C are water soluble.

Vitamin A, chemically known as retinol is essential for normal vision, growth, cell differentiation and gene expression, immunity and reproduction and offers protection against cancer, cardiovascular diseases, cataracts and gastric inflammation due to its antioxidant property.

Vitamin A Deficiency (VAD) is a major health problem among pre-schoolers and pregnant women in lower socio economic groups. It is

predicted by NNMB that Indian pre-schoolers consume only 50% of the RDA of vitamin A.

Epidemiology

VAD causes more than 250,000 children to go blind in Asia each year; 52,500 such cases per year are from India. Although the incidence rate has significantly reduced due to continuous massive supplementation and immunization efforts taken by the Government the prevalence of sub-clinical VAD is significantly higher in all the states among pre-schoolers, which is also associated with increased morbidity and mortality risk. As deficiency of Vitamin A cover wide range of health effects it is still considered important to know the causes and preventive measures.

To begin with we shall discuss the aetiology or causes of Vitamin A deficiency.

Aetiology

Age: Vitamin A deficiency is rare in infancy but manifests predominantly in pre-schoolers. VAD devastates with Severe Protein Energy Malnutrition. The incidence of corneal xerophthalmia is common between 1 and 3 years.

Socio Economic Factors: Low income is a major contributing factor as for any deficiency, because the expense made towards nutritious food is minimal. Animal foods like egg, milk and liver which contain preformed Vitamin A and assure complete absorption and utilisation are expensive. Even though low cost foods like green leafy vegetables and papaya are rich in beta carotene, due to ignorance and wrong traditional beliefs they are avoided in the diet of children and pregnant women. Also, the potential benefits of Vitamin A supplementation, immunisation and other basic health services like diarrhoea prophylaxis are not utilised by the needy due to lack of awareness.

Inadequate Dietary Intake: Then may have a poor store of Vitamin A if the pregnant and lactating mothers are Vitamin A deficient. Breast milk is a good source of Vitamin A, but delayed weaning and inadequate supplementation deplete the hepatic stores of vitamin A and subsequently the child becomes Vitamin A deficit during pre-school age.

Infections: The common childhood infections like diarrhoea, measles, respiratory tract infections and parasite infestations interfere with absorption of Vitamin A leading to Vitamin A deficiency. Certain chronic infectious diseases, Urinary Tract Infections and cancer increases Vitamin A excretion causing deficiency.

Improper Cooking Methods: Cooking in presence of too much oil causes loss of Vitamin A. Hence, to reduce cooking loss use much less oil. Boiling or prolonged heating at very high temperatures causes deleterious effect in carotene retention.

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Next, it is necessary to understand the clinical signs and symptoms to identify the VAD subjects.

Signs and symptoms

Clinical signs and symptoms are shown only after the liver stores deplete.

Vitamin A deficiency initiates with ocular manifestations termed as xerophthalmia in different stages. Nutritional blindness due to xerophthalmia is the most significant problem in young children.

Night Blindness (XN): Vitamin A is involved directly in the dark adaptation- the capacity of the eye to adapt to vision in dim light after exposure to bright light. Those deficient in vitamin A usually cannot see in dim light either at dusk or dawn as the formation of rhodopsin is hindered in vitamin A deficiency causing poor night vision. Often pregnant women experience deficiency symptoms such as night blindness that continues into the early period of lactation. Night blindness of VAD and is often present without any signs of xerophthalmia. It is a useful screening tool and response well to treatment.

Conjunctival Xerosis (X1A): Conjunctival Xerosis is characterised by dry patches of non-wettable conjunctiva. The conjunctiva appears thick, wrinkled and pigmented (muddy colour) with a peculiar smoky appearance. This is commonly observed in children under 5 years more likely due to dietary VAD.

Bitot's spot (X1B): The process progress dirty white foamy raised dry triangular patches on the surface of the conjunctiva. They are not easily diagnosable.

Corneal Xerosis (X2): The dryness spreads from conjunctiva to cornea causing erosion of a part or the whole of corneal thickness. This is due to keratinisation on epithelial surface because of VAD. Child tends to keep the eyes closed particularly in bright light due to photophobia. If there is secondary infection there is inflammation. The lesion only heals by scarring. Corneal Xerosis if not treated properly progress to keratomalacia.

Corneal Ulcer (X3A): If there is secondary infection there is inflammation. The lesion only heals by scarring. This is known as ulceration of cornea. Initially the ulcer may be shallow and if it becomes deep it leads to perforation resulting in prolapse of contents of eyeball. Corneal ulcer if not treated properly progress to keratomalacia.

Keratomalacia (X3B): Keratomalacia consists of softening and dissolution of the cornea leading to deformation or destruction of eyeball. The corneal structure melts into a cloudy gelatinous mass dead white or dirty yellow in colour. If not treated immediately prolapse of the iris, extrusion of the lens and loss of vitreous may occur.

Corneal scarring (XS): Healing of keratomalacia results in scarring of the whole eye and frequently in total blindness.

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Table 4.5 Classification of Vitamin A Deficiency and the Age Groups Most Affected -WHO

Grade of xerophthalmia	Peak age group (years)	Type of Deficiency	Risk of death
XN - Night blindness	2–6; adult women	Longstanding. Not blinding	+
X1A -Conjunctival Xerosis	3–6	Longstanding. Not blinding	+
X1B -Bitot's spot	3–6	Longstanding. Not blinding	+
X2-Corneal Xerosis	1–4	Acute deficiency. Can be blinding	++
X3A -Corneal ulcer/ <1/3 cornea	1–4	Severe acute deficiency. Blinding	+++
X3B -Corneal ulcer/keratomalacia $\geq 1/3$	1–4	Severe acute deficiency. Blinding	++++
XS - Corneal scarring (from X3)	>2	Consequence of corneal ulceration	+/-
XF-Xerophthalmic fundus	Adults	Longstanding. Not blinding. Rare	-

Effect on Growth: Growth is retarded in VAD due to impairment in skeletal formation.

Effect on Reproduction: Degeneration of germinal epithelium leads to sterility in males. Termination of pregnancy due to foetal death is observed in females as a consequence of VAD.

Increased Susceptibility to Infection: Vitamin A is required for proper activity of the immune system. Once an infection has taken hold it can aggravate a pre-existing VAD leading to greater risk of further infections and perhaps eventual death. It is also known that VAD increases risk of respiratory infections, diarrhoea and measles. The immune response to certain antigens in vitamin A depleted children are enhanced by vitamin A supplementation.

In addition to the above mentioned manifestations thickening of hair follicles- **follicular hyperkeratosis** is a cutaneous manifestation of VAD.

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Figure 4.4: Signs of Xerophthalmia

Diagnosis

Apart from the clinical signs and symptoms various biochemical indices that had been discussed in Unit- 2 will help in assessing the Vitamin A status. Few parameters are depicted in the table below for easy learning.

Table 4.6: Biochemical Indices of Vitamin A Status

Parameters	Values
Liver Retinyl Ester	
Adequate	>20 mg/kg
Deficient	<5 mg/kg
Plasma Retinol	
Normal	200-500 mcg/l
Unsatisfactory	100-200 mcg/l
Plasma Retinol Binding Protein	
Adults	40-90 mcg/l
Pre-School Children	25-35 mcg/l
Relative Dose Response	
Normal	<20%
Marginal Deficiency	>20%

There is no single effective indicator in determining VAD, so along with biochemical assessment, the following evaluation will also help in early diagnosis.

Conjunctival Impression Cytology: A piece of cellulose acetate filter paper is brought in contact with the conjunctiva. Microscopic examination of the cells adhered to the filter paper is done after suitable staining. Characteristic changes of conjunctiva i.e. Xerosis or dryness can be identified before apparent clinically.

Dark Adaptation Test: This measures the speed of recovery of vision in dim light. This is an accurate and sensitive measure of vitamin A status.

Breast Milk Retinol: The ratio of vitamin A to fat in breast milk is a better indicator of vitamin A status than Vitamin A concentration alone.

Treatment

Vitamin A Deficiency having a community health significance the treatment is done at a large scale. MDVA (Massive Dose Vitamin A Programme) administers vitamin A in oil as per the schedule shown in the table 4.7. Along with Vitamin A supplementation infection should be controlled by antibiotics, and since 90% of VAD is associated with kwashiorkor or marasmus, treatment for PEM should also be initiated simultaneously.

Table 4.7: Treatment of Xerophthalmia in All Ages (WHO)

Timing of Dose	Children (0- 5 months)	Children (6-12 months)
Immediately on Diagnosis	50000 I.U	100000 I.U
The following day	50000 I.U	100000 I.U
Subsequently (at least 2 weeks later)	50000 I.U	100000 I.U

If VAD is observed in women of reproductive age a daily dose of 10000 I.U for 2 weeks or a weekly dose of 25000 I.U of vitamin A in oil for 4 weeks is recommended.

Table 4.8 Recommended Dietary Allowances of Retinol and Beta Carotene

Group	Retinol mcg/day	Beta carotene mcg/day
Man	600	4800
Women	600	4800
Pregnancy	800	6400
Lactation	950	7600
6-12 months	350	2100
1-6 years	400	3200
7-9 years	600	4800
10-17 years	600	4800

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Source: ICMR, 2010

Prevention

The preventive mechanism for VAD also encompasses a comprehensive strategy of Dietary Modifications, Fortification, Supplementation and Nutrition Education.

Dietary Modifications: A daily diet rich in green leafy vegetables and yellow orange fruits and vegetables like mango, papaya and carrot are rich sources of beta-carotene, precursor of vitamin A. Dairy products and eggs are rich sources of retinol, highly bioavailable form of vitamin A. Spirulina, a blue green algae provides 3,20,000 mcgs of beta carotene /100gms. Red palm oil is also a rich source of vitamin A.

Fortification: All hydrogenated fats and vegetable oils are expected to be fortified with vitamin A. Toned and double toned milk can be fortified with 1000 I.U vitamin A for 500ml, as done by Aavin. Salt is fortified with Vitamin A 2000I.U/ 10g. All special children foods and low cost processed foods supplied for preschool and school children under Government schemes are fortified with Vitamin A.

Biofortification: Fortification of crops is termed as Biofortification. Golden rice fortified with pro-vitamin A is a boon to prevent VAD at a hefty measure.

Supplementation: The National Prophylaxis Programme against Nutritional Blindness implemented since 1970 administers a massive dose of 200000 I.U of vitamin A in oil every six months for pre-schoolers. Under the Child Survival and Safe Motherhood programme since 1992, a first dose of 100000 I.U of vitamin A is administered at 9 months along with measles vaccine, subsequently 200000 I.U at 18, 24, 30 and 36 months along with DPT booster dose.

Nutrition Education: Proper education and creating awareness among mothers about the functions and ill effects of vitamin A deficiency will help overcome VAD. Education on early initiation of breast feeding, feeding of colostrum, exclusive breast feeding for first 4-6 months, initiation of early weaning and supplementation practices with vitamin A rich foods like carrots, pumpkins, papaya, greens and mango and eggs can help in preventing VAD.

Check Your Progress

5. How do you treat xerophthalmia?

6. Discuss the strategies to prevent VAD.

4.5.3 Iodine Deficiency Disorder

Iodine is an element that is required for the normal physical and mental growth. The total body contains 15-23mg of iodine of which 75% is present in thyroid gland. Hence iodine plays an important role in the production of thyroid hormone, triiodothyronine (T3) and thyroxine (T4). The body does not make iodine, so it should form an essential part of the diet absence of which leads to Iodine Deficiency Disorders(IDD) with wide variety of physical and neurological disorders. The term IDD encompass a spectrum of disabling conditions starting foetal life to adulthood.

Epidemiology

Even though iodine is required in trace amounts it is not being provided for effective functioning. About 1.5 billion of the world population are at the risk of IDD, of which more than 200 million are in India. Traditionally the endemic belt of goiter in our country stretches across the entire Sub-Himalayan belt extending from Jammu and Kashmir to Arunachal Pradesh. Several pockets of endemic goiter are also identified in the Aravalli hills of Rajasthan, Sub-Vindhya hills of Madhya Pradesh, Narmada valley of Gujarat, hilly areas of Odisha and Andhra Pradesh, tea estates of Karnataka, Kerala districts. Coastal areas are free of IDD. As estimated by NIN, Hyderabad the overall prevalence of IDD among 6-11 years old children was about 4% with higher proportion in Maharashtra (11.9%) and West Bengal (9%). Survey by the directorate general of health services, Government of India has estimated the prevalence of IDD ranging from 10% in Ranchi district to 96% in some districts of Mizoram. More than 54 million people are suffering from endemic goitre and 8.8 million from different grades of mental and motor changes. Around 4% of the children in the districts of UP and Bihar were affected with deaf mutism, mental retardation and other clinically detectable defects attributable to environmental iodine deficiency.

Etiology

As understood, IDD is an ecological phenomenon due to leaching of soil by floods or high rainfall in the mountainous regions causing soil to be iodine deficient. Thus it is established that the factors responsible for IDD are mainly environmental and in some instances intrinsic factors also play role.

Environmental Factors: Iodine is predominantly present in deep well water and sea water @50-60 mcg/l. The rain formed from the condensation of sea water enrich the top layers of soil with iodine. High rainfall, snow, flooding and erosion increases the loss of soil iodine by stripping off the

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fertile top layers of soil. Crops grown in these soils are low in iodine. As a result the populations consuming foods grown in such soils become iodine deficient. When the water levels of iodine falls below 2 mcg/l, the inhabitants of those regions become iodine deficient.

Goitrogens: Goitrogens are substances that interfere with the iodine metabolism at different stages including iodine uptake and conversion of thyroxine to triiodothyronine. The inhibition of enzymes which catalyze these reactions also interfere with iodine metabolism causing iodine deficiency. Goitrogens are classified into different classes based on the stage of inhibition as listed below:

Class I: Thiocyanate and isothiocyanates found in cassava, cabbage, turnips, broccoli, brussels sprouts, cauliflower, radish and mustard, and cyanogenic glycosides from the seeds and edible parts of apples, apricots, cherries, peaches, plums, almonds, stone fruit, cassava, bamboo shoots, linseed/flaxseed, lima beans, coco yam, chick peas, and cashews inhibit iodine uptake by thyroid gland.

Class II: Thiourea, thionamides and flavonoids found in cruciferous vegetables affects the stages of organification and coupling in the process of synthesis of thyroxine.

Class III: Excess iodine and lithium interfere at the proteolysis stage, affecting utilization of thyroxine.

The red skin of groundnut (arachidoside), antibiotics sulphonamides and PABA have goitrogenic effect. Goitrogens concentration in the food is subject to regional variation. However, cooking inactivates goitrogens.

Intrinsic Factors: Rare congenital defects can inhibit thyroid hormone synthesis causing IDD.

Forms of Iodine Deficiency Disorder

IDD manifests at all stages of life from foetus to adulthood, as various forms of disorders. Each one of them are discussed in detail below:

Stillbirth: Thyroid and Pituitary develops by the 12th week of gestation and Thyroid Stimulating Hormone (TSH) can be detected in blood between 18 and 22 weeks. In gestation, the T4 converts to reverse T3 which has no hormonal activity, but just before birth, the reverse T3 levels fall and biologically active T3 level rises, preparing the organism for transition from intrauterine to extrauterine life. In case of iodine deficiency, the conversion fails and insufficient T3 levels may be a causative factor for stillbirths.

Goitre: Non-neoplastic, non-inflammatory non-toxic and painless enlargement of thyroid gland due to lack of iodine required for the synthesis of thyroid hormones is goitre.

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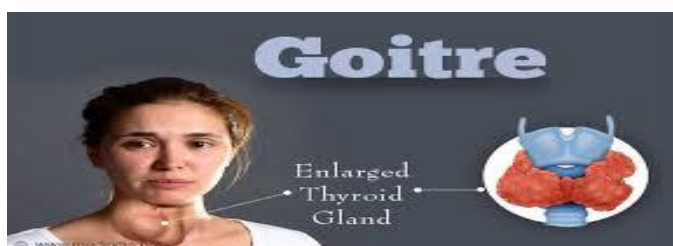


Figure 4.5: Enlarged thyroid gland-Goitre

The high levels of TSH cause an increase in number and size of cells of thyroid gland. Adolescent girls, women and school children are more susceptible. Administration of appropriate doses of iodine can correct the condition. Classification of goitre based on the severity is tabulated below.

Table 4.9 Classification of Goitre (WHO)

Grade	Signs and symptoms
Grade 0	No visible goitre.
Grade 1	Enlarged thyroid, but not visible when the neck is in normal position. On swallowing the mass moves upward in the neck. Nodular alterations can occur even when the thyroid is not enlarged.
Grade 2	Visible from minimum distance.
Grade 3	Swelling visible when the neck is in normal position and is consistent with an enlarged thyroid when the neck is palpated.

Cretinism: Severe iodine deficiency in intrauterine life causes cretinism. Cretinism is classified into two types:-

Neurological cretinism: Symptoms includemental retardation, deaf - mutism, squint, and spastic rigidity affecting the lower limbs. Iodine deficiency during the 2nd and 3rd trimester of pregnancy affect the inner ear and brain development of foetus leading to neurological cretinism.

Myxoedematous cretinism: Coarse and dry skin, swollen tongue, deep hoarse voice, apathy and mental retardation associated with skeletal growth retardation and weak abdominal muscle is observed. Myxoedematous cretinism occurs as a result of iodine deficiency during later stages of pregnancy and early stages of infancy. Goitrogens consuming population are at a higher risk of developing Myxoedematous cretinism.

Hypothyroidism: Elevated TSH levels and low serum T4 levels due to iodine deficiency in adults cause hypothyroidism. Coarse and dry skin, husky voice and delayed tendon reflexes are characteristics of hypothyroidism.

Psychomotor Defects: In children iodine deficiency manifests as low IQ, poor school performance, apathy and poor motor coordination

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.10 Symptoms of IDD

Recognizing hypothyroid symptoms	
Hypothyroidism affects every body system. Some key symptoms are listed below.	
Body system	Hypothyroid symptoms
Cardiac	<ul style="list-style-type: none"> • Bradycardia (can reduce cardiac output and decrease endurance) • Heart enlargement (late-stage hypothyroidism) • Flattened T waves • Hypertension
Central nervous system/metabolic	<ul style="list-style-type: none"> • Cold intolerance • Elevated cholesterol levels • Excessive sleep and fatigue • Slowed thinking and inability to concentrate • Weight gain
Ear, nose, and throat	<ul style="list-style-type: none"> • Enlarged tongue • Goiter • Puffy eyes
Integumentary	<ul style="list-style-type: none"> • Brittle nails • Coarse, thinning hair • Dry skin that looks older than stated age • Loss of body hair
Genitourinary	<p>Women:</p> <ul style="list-style-type: none"> • Heavy periods • Infertility • Irregular periods <p>Men:</p> <ul style="list-style-type: none"> • Decreased libido • Delayed ejaculation • Erectile dysfunction
Gastrointestinal	<ul style="list-style-type: none"> • Celiac disease (four times more common in patients with hypothyroidism than in the general population) • Constipation • Decreased taste sensation • Gastric atrophy resulting in pernicious anemia
Musculoskeletal	<ul style="list-style-type: none"> • Carpal tunnel syndrome • Muscle weakness and cramping • Slowed reflexes

Source: americannurses.com

Diagnosis

The clinical signs and symptoms are effective indicators of IDD. As a tool for confirmation the biochemical parameters play a significant role in determining iodine deficiency and the interpretation for the same is given in the table 4.11 and 4.12.

Table 4.11 Thyroid Function Tests

Parameter	Normal
T3	100-200ng /dl
T4	4-12 mcg/dl
Serum TSH	<1-4 mU/l

NOTES**Table 4.12: Thyroid Function Test Interpretation**

Thyroid Function Test Interpretation			
TSH	Free T4	Free T3	Condition
Normal	Normal	Normal	• None
Low	High	High	• Hyperthyroidism
Low	Normal	Normal	• Subclinical hyperthyroidism
Low	Normal	High	• T3 toxicosis
Low	High	Normal	• Thyroiditis • T4 ingestion • Hyperthyroidism in the elderly or with comorbid illness
Low	Low	Low	• Euthyroid sick syndrome • Central hypothyroidism
High	Normal	Normal	• Subclinical hypothyroidism • Recovery from euthyroid sick syndrome
High	Low	Low	• Primary hypothyroidism
High	High	High	• TSH producing pituitary adenoma

A new born with T4 levels less than 3mcg/dl and TSH level 50mU/l is considered as having neonatal hypothyroidism and is a sensitive indicator of environmental iodine deficiency.

Prevention

Regular consumption of diets with food sources of iodine and the quantity meeting the daily recommended allowances will help prevent IDD. The RDA given by ICMR, 2010 and food sources are listed below.

Table 4.13 Recommended Dietary Allowances of Iodine

Group	Iodine(mcg/day)
Adult	150
Pregnancy	200
Lactation	200
Infants	90
1-5years	90
6-12 years	120
Adolescents >12	150

Food Sources: The iodine content of foods depends on the iodine content of soil from where it is grown. Sea foods such as marine fish and shell fish are rich source of iodine providing around 144 to 328 mcg/100g. The

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iodine content of egg is about 50mcg/100g and egg white is a more concentrated source. Milk has 18-22 mcg/100ml. Sorghum (73 mcg/100g), black gram (48 mcg/100g) and mustard (55 mcg/100g) are sources of iodine from plants foods. Typically, the iodine content of animal foods depends on the iodine present in the foods animals consume and plant iodine depends on the soil and water content of iodine in the places of their growth. A standard Indian diet in non-goitre areas provide 200mcg of iodine per day, cooking losses amount to 37-70% of iodine, however the iodine present will be sufficient to meet the daily requirements, since the mean requirement is 100-150mcg/day.

The National IDD control programme implemented in 1992 by Dept. of Health, Govt. of India has aimed at ensuring production and supply of iodised salt at low cost to all goitre endemic areas. The essential components of this NIDDCP includes iodine fortification, monitoring and surveillance, manpower training and mass communication. Let us study each one in detail in unit VIII.

It is important to high light that the intervention measures by Indian Government has reduced the prevalence of IDD significantly.

Check Your Progress

Write a short note on goitrogens.

Explain the preventive measures for IDD.

4.6 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

1. Immunity, is defined as the capacity or ability of the human body to resist the toxins or organisms that tend to damage the tissues and organs. There are two principal types of immunity: innate or natural immunity and acquired, inherited or adaptive immunity.

Innate or Natural Immunity: Immunity with which an individual is born is called innate or natural immunity. Innate immunity is the first line of defense towards pathogens. Innate immunity is provided by various components such as Skin, mucus membrane, Phagocytic cells (Neutrophils, macrophages, and dendritic cells) through the mechanism of phagocytosis- The process by which phagocytes ingest or engulf other cells or particles which are foreign to the host.

Acquired or Adaptive Immunity: Adaptive immune response is the second line of defense against non-self-pathogens. Adaptive immunity is also referred to as acquired immunity or specific immunity and is only found in vertebrates. Adaptive immunity works slower than innate, and is specific. The adaptive immune response is specific to the pathogen presented. The adaptive immune response is meant to attack non-self-pathogens but can sometimes make errors and attack itself. When this happens, autoimmune diseases can develop (e.g., lupus, rheumatoid

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arthritis). Acquired immunity is of two types viz: Humoral or B cell immunity, the body develops circulating antibodies which are globulin molecules that are capable of attacking the invading agent. In cell mediated or T cell immunity, large number of activated T lymphocytes that are specifically designed to destroy the foreign material are formed.

2. Bacterial Infection: A bacterial contamination is a proliferation of a harmful strain of bacteria on or within the body. One-third of the world's population is infected with *Mycobacterium tuberculi*, the main agent that provokes death among infectious diseases, causing tuberculosis. This infection is particularly influenced by under nutrition and often co-exists with PEM. Gastroenteritis is another example of bacterial infection which causes high mortality among malnourished infants and preschool children causing inflammation of the stomach and persistent vomiting and diarrhoea, and weanling diarrhoea common among weaned malnourished infants can be cited to associate the relationship between nutritional status and incidence of infection. Pneumonia, meningitis, and food poisoning are also a few illnesses that can be resulting from dangerous bacteria. Noma is an opportunistic infection promoted by extreme poverty that evolves rapidly from a gingival inflammation to mutilating orofacial gangrene, as a result of very complex interactions among malnutrition, infection and compromised immunity. *Fusobacterium necrophorum* and *Prevotella intermedia* are the bacterial pathogens causing noma. Bacterial infections decreases the absorption of nitrogen and increases excretion of nitrogen in urine and disposes to secondary anorexia. Thus, in such infections, the need for protein and other nutrients increases, else diarrhoea instigated as an acute infection end as chronic diarrhoea.

Viral Infection: Infection resulting from the presence of a pandemic in the body due to virus. Depending on the state of health, numerous viruses can infect nearly any form of body tissue, from the brain to the skin. Examples include children with PEM suffers from influenza and measles. Even though effective vaccines are licensed for measles, it continues to cause death and severe disease in children worldwide. Complications from this viral infection can occur in almost every organ or system.

Parasitic Infection: A parasitic ailment, referred to parasitic diseases can have an effect on nearly all living organisms, with low immune stature. Malarial parasites cause hemolytic anaemia and deplete protein reserves. Hookworm infestation causes blood loss leading to anaemia. Ascariasis, small intestine infection is another example instigated by *Ascaris lumbricoides*, which is a species of roundworm prevalent in areas of poor sanitation and hygiene that interferes with absorption of nutrients in children. The coexistence between under nutrition and nematode infection encompasses two connecting trails, malnutrition that augments susceptibility to infection and the infection itself that leads to a more accentuated under nutrition. Intestinal nematodes provoke

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malnutrition causing anorexia and a variety of pathophysiological disturbances in the gastrointestinal tract such as vomiting, diarrhea and mal absorption. All these put together, affect the ability of the child to acquire sufficient nutrients from the diet. Parasites namely helminths, *Giardia duodenalis*, *Entamoeba histolytica*, coccidia and *Schistosoma* sp. that affect the nutritional status of the children, incite if the host is weak and the environment is unhygienic are mostly transmitted through soil.

3. Nutritional anaemia occurs as a result of the inability of erythropoietic cells to maintain normal hemoglobin status, on account of inadequate supply of one or more nutrients leading to fall in total hemoglobin production and circulation. **Food Sources:**

Haeme iron-liver, red meat like beef and lamb. **Non-haeme iron**-cereals, millets like bajra and ragi, pulses and Green Leafy Vegetables. Haeme iron is better absorbed than non-haeme iron.

4. Inadequate Dietary Intake: The habitual cereal – legume based diet, even though contains adequate amount of iron, the availability of iron from this diet is only from 3 to 5%, proving a precipitating factor for iron deficiency anaemia. Also, good mineral diet is also a decent source of tannins and phytates which interfere with the iron absorption to a significant extent. The chemically determined iron content of Indian diet is 15mg / 1000 calories, but the availability is merely around 70%, providing only 10mg/1000 calories, which is sufficient to meet the RDA of men and pre-schoolers, provided their dietary intake meets the energy requirements. However, the vulnerable groups, women of reproductive age are susceptible for anaemia hence their diet should be enriched with heme iron from non-vegetarian sources or supplemental iron should be provided. **Inadequate Absorption and Utilization:** Chronic gastrointestinal disturbances, defective release of iron from iron stores into plasma and poor iron utilisation due to inflammation can also cause anaemia. Gastrectomy impairs iron absorption because of achlorhydria and decreased transit time through the duodenum. **Infections:** As discussed earlier in this chapter, hookworm infection, Tuberculosis, diarrhoea and PEM are causative factors for anaemia to occur. **Causative Factors in women:** Excessive blood loss during menstruation, child birth, repeated and closely spaced pregnancies, prolonged lactation deplete iron store in women causing anaemia. **Increased Demand:** Life stages of increased demands like infancy, where the blood volume rapidly expands, adolescence-rapid growth and onset of puberty in girls' anaemia is common, if the demand is not met. **Decreased Stores:** Pre term, Pre mature babies, twins may have decreased iron stores and are susceptible for anaemia. **Socio Economic Factors:** Poverty and ignorance are contributing factors for any deficiency diseases. Despite the fact, that locally available inexpensive foods like green leafy vegetables are good sources of iron, bioavailability is more only in expensive animal foods. Ignorance issues like consumption of tea or any tannin or phytates rich foods that interfere with iron absorption, along

with an iron rich food also leads to anaemia.

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Timing of Dose	Children (0- 5 months)	Children (6-12 months)	Children over 12 months, male (adolescent & adult)
Immediately on Diagnosis	50000 I.U	100000 I.U	200000 I.U
The following day	50000 I.U	100000 I.U	200000 I.U
Subsequently (atleast 2 weeks later)	50000 I.U	100000 I.U	200000 I.U

If VAD is observed in women of reproductive age a daily dose of 10000 I.U for 2 weeks or a weekly dose of 25000 I.U of vitamin A in oil for 4 weeks is recommended.

6. Dietary Modifications: A daily diet rich in green leafy vegetables and yellow orange fruits and vegetables like mango, papaya and carrot are rich sources of beta-carotene, precursor of vitamin A. Dairy products and eggs are rich sources of retinol, highly bioavailable form of vitamin A. Spirulina, a blue green algae provides 3,20,000 mcgs of beta carotene /100gms. Red palm oil is also a rich source of vitamin A. **Fortification:** All hydrogenated fats and vegetable oils are expected to be fortified with vitamin Toned and double toned milk can be fortified with 1000 I.U vitamin A for 500ml, as done by Aavin. Salt is fortified with Vitamin A 2000I.U/ 10g. All special children foods and low cost processed foods supplied for preschool and school children under Government schemes are fortified with Vitamin A. **Biofortification:** Fortification of crops is termed as Biofortification. Golden rice fortified with pro-vitamin A is a boon to prevent VAD at a hefty measure. **Supplementation:** The National Prophylaxis Programme against Nutritional Blindness implemented since 1970 administers a massive dose of 200000 I.U of vitamin A in oil every six months for pre-schoolers. Under the Child Survival and Safe Motherhood programme since 1992, a first dose of 100000 I.U of vitamin A is administered at 9 months along with measles vaccine, subsequently 200000 I.U at 18, 24, 30 and 36 months along with DPT booster dose. **Nutrition Education:** Proper education and creating awareness among mothers about the functions and ill effects of fwill help overcome VAD. Education on early initiation of breast feeding, feeding of colostrum, exclusive breast feeding for first 4-6 months, initiation of early weaning and supplementation practices with vitamin A rich foods like carrots,

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pumpkins, papaya, greens and mango and eggs can help in preventing VAD.

7. Goitrogens: Goitrogens are substances that interfere with the iodine metabolism at different stages including iodine uptake and conversion of thyroxine to triiodothyronine. The inhibition of enzymes which catalyze these reactions also interfere with iodine metabolism causing iodine deficiency. Goitrogens are classified into different classes based on the stage of inhibition as listed below:

Class I: Thiocyanate and isothiocyanates found in cassava, cabbage, turnips, broccoli, brussels sprouts, cauliflower, radish and mustard, and cyanogenic glycosides from the seeds and edible parts of apples, apricots, cherries, peaches, plums, almonds, stone fruit, cassava, bamboo shoots, linseed/flaxseed, lima beans, coco yam, chick peas, and cashews inhibit iodine uptake by thyroid gland.

Class II: Thiourea, thionamides and flavonoids found in cruciferous vegetables affects the stages of organification and coupling in the process of synthesis of thyroxine.

Class III: Excess iodine and lithium interfere at the proteolysis stage, affecting utilization of thyroxine.

The red skin of groundnut (arachidoid), antibiotics sulphonamides and PABA have goitrogenic effect. Goitrogens concentration in the food is subject to regional variation. However, cooking inactivates goitrogens.

8. Regular consumption of diets with food sources of iodine and the quantity meeting the daily recommended allowances will help prevent IDD. The RDA and food sources are listed below.

Recommended Dietary Allowances of Iodine

Group	Iodine mcg/day
Adult	150
Pregnancy	200
Lactation	200
Infants	90
1-5years	90
6-12 years	120
Adolescents >12	150

Food Sources: The iodine content of foods depends on the iodine content of soil from where it is grown. Sea foods such as marine fish and shell fish are rich source of iodine providing around 144 to 328 mcg/100g. The iodine content of egg is about 50mcg/100g and egg white is a more concentrated source. Milk has 18-22 mcg/100ml. Sorghum (73 mcg/100g), black gram (48 mcg/100g) and mustard (55 mcg/100g) are sources of iodine from plants foods. Typically, the iodine content of animal foods

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depends on the iodine present in the foods animals consume and plant iodine depends on the soil and water content of iodine in the places of their growth. A standard Indian diet in non-goitre areas provide 200mcg of iodine per day, cooking losses amount to 37-70% of iodine, however the iodine present will be sufficient to meet the daily requirements, since the mean requirement is 100-150mcg/day. **Iodine fortification:** The main vehicles for fortification of iodine are salt, sugar, wheat flour, bread, milk and water.

4.7 SUMMARY

This unit has taught us the sequential occurrence of infection and malnutrition. On discussing the micronutrient deficiencies, we have learnt that the iron deficiency anaemia, Vitamin A deficiency and iodine deficiency disorders are of public health significance. The vulnerable groups for these micronutrient deficiencies are pre-schoolers, school going children, adolescents and women of reproductive age. Men are least affected.

Consequences of anaemia include maternal and perinatal mortality, low birth weight, reduced physical work capacity and poor mental ability, while vitamin A deficiency manifests predominantly as ocular lesions. IDD causes stillbirth, abortions, goitre and cretinism.

Prevention of all three deficiencies include an inclusive strategy of supplementation, food fortification and proper nutrition education.

4.8 KEY WORDS

- **Deaf Mutism:** A person who is deaf and dumb.
- **Goitrogens:** Goitrogens are substances that interfere with the iodine metabolism
- **Anemia:** Low level of hemoglobin in blood.
- **Xerophthalmia:** A deficiency encompassing all ocular lesions.

4.9 SELF ASSESSMENT QUESTIONS AND ANSWERS

Short Answer Questions

1. Explain the vicious cycle of malnutrition and infection.
2. What are the different types of anemia?
3. Mention the RDA of iron and biochemical indicators of anemia.
4. Brief the importance of vitamin A.
5. State the thyroid function tests and its interpretation to determine IDD.

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Long Answer Questions

1. Elaborate on the role of infection on nutrients and nutritional status.
2. Explain the clinical findings of iron deficiency anaemia.
3. Narrate the measures to overcome iron deficiency anaemia.
4. Explain the manifestations of Vitamin A deficiency.
5. Enumerate the signs and symptoms of IDD.

4.10 FURTHER READINGS

- Suryatapas, 2018, Textbook of Community Nutrition, 3rd Edition, Academic Publishers, West Bengal.
- Prabha Bisht, 2017, Community Nutrition in India, Star Publications, Agra.
- Srilakshmi.B,2016, Nutrition Science, New Age International Publishers, New Delhi.
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BLOCK – II: MALNUTRITION IN INDIA AND NUTRITION INTERVENTION PROGRAMMES

Prevalence of malnutrition in India

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UNIT- 5 PREVALENCE OF MALNUTRITION IN INDIA

Structure

- 5.0 Introduction
- 5.1 Objectives
- 5.2 Malnutrition in India
 - 5.2.1 Prevalence
 - 5.2.2 Morbidity and Mortality Rate
- 5.3 Common nutritional problems
 - 5.3.1 Macro minerals
 - 5.3.2 Micro minerals
 - 5.3.3 Fat soluble vitamins
 - 5.3.4 Water soluble vitamins
- 5.4 Answer to check your progress questions
- 5.5 Summary
- 5.6 Key Words
- 5.7 Self-Assessment Questions
- 5.8 Further Readings

5.0 INTRODUCTION

We have discussed enough about malnutrition in our previous units. Now in this unit we shall discuss about the common macro and micro minerals and vitamin deficiencies that are in common prevalence. Malnutrition alludes to inadequacies, overabundances or uneven characters in an individual's admission of vitality as well as supplements. The term malnutrition covers two general gatherings of conditions. One is 'under nutrition'— which incorporates stunting (low stature for age), wasting (low weight for tallness), underweight (low weight for age) and micronutrient inadequacies or deficiencies (an absence of significant nutrients and minerals). The other is overweight, weight and diet-related non-communicable ailments, (for example, coronary illness, stroke, diabetes and malignant growth). In this unit, the common nutritional problems have been categorized based on the nutrient classification as macro and micro minerals deficiency diseases and fat and water soluble vitamins deficiency

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diseases and discussed so that the learners will have a clear and easy understanding.

5.1 OBJECTIVES

After going through this unit, you will be able to:

Discuss malnutrition in India

- Prevalence rate of malnutrition in India
- Common nutritional problems
- Prevalence, morbidity and mortality rate of common nutritional problems

5.2 MALNUTRITION IN INDIA

As, we know the malnutrition can be due to under nutrition or over nutrition. In unit 3 the prevalence, morbidity and mortality due to Protein Energy Malnutrition had been discussed in detail. In this unit, we shall study about the prevalence, morbidity and mortality due to over nutrition and other common nutritional problems arising due to vitamin and mineral deficiencies.

5.2.1 Prevalence

India's exhibition on key lack of malnutrition pointers is poor as per national and global investigations. As indicated by UNICEF, India was at the tenth position among nations with the most noteworthy number of underweight children, and at the seventeenth place for the most elevated number of stunted children in the world. Lack of malnutrition influences odds of survival for youngsters, builds their vulnerability to ailment, diminishes their capacity to learn, and makes them less profitable in later life. It is evaluated that malnutrition is a contributing component in around 33% of preschoolers performance lag. India's record of high economic growth over the past decade has not transformed the nutritional status of its population to the extent necessary. Latest research shows that despite doubling the rate of stunting reduction in the past 10 years from the previous decade, India still has the largest share of the world's undernourished population. Among adults, 23% of women and 20% of men are viewed as undernourished in India. Then again, 21% of women and 19% of men are overweight or stout. The synchronous event of over nutrition and under-nourishment demonstrates that grown-ups in India are experiencing a double burden of malnutrition (unusual slimness and corpulence), which points to 56% of women and 61% of men.

According to FAO (2015) about 795 million people in the world i.e. 1 in 9 ratio are suffering from chronic under nutrition. Of this 12.9% (780 million) are living in developing countries

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The World Bank has declared that with 40 percent of its workforce having experienced stunting as children, India is simply not going to be able to compete in the future economy. Also, World Bank's recent report on Nutrition, says India loses over \$12 billion in GDP to vitamin and mineral deficiencies. 48% of children under the age of five years are stunted, 43 per cent are underweight, 20 per cent are wasted, and more than 1 in 4 infants are born with a low birth-weight. Indeed, in terms of undernutrition the Global Hunger Index (GHI) ranked India at 103 among 119 countries in 2018. At the same time, overnutrition is emerging as a silent epidemic in many parts of the country, and the current healthcare delivery system is barely equipped to deal with this additional policy challenge. The Harvard TH Chan School of Public Health, US, (2018) has reported that by 2050, India will be bearing the greatest burden of having 50 million zinc deficient people, 38 million protein deficient people and 502 million iron deficient children and women, because of increasing carbon dioxide in the air which is currently making staple crops rice and wheat less nutritious.

5.2.2 Morbidity and Mortality Rate

We have studied in unit 2 that, Morbidity rate refers to number of people fall prey to particular disease, while mortality rate refers to number of deaths due to certain diseases. On one hand, the rise of malnutrition due to poverty and poor environmental conditions are on the rise, which has been studied in detail under unit 3. The other side, leads to increase in the diet related Non- Communicable Diseases (NCDs) due to over nutrition. NCDs are the diseases which cannot be transmitted from one person to another, but caused mainly due to food habits and life style patterns. Heart diseases, diabetes, Parkinson's disease, autoimmune diseases, strokes, cancers, chronic kidney disease, osteoarthritis, osteoporosis, Alzheimer's disease, cataracts are some examples of NCDs. Due to economic transition, the western diet high in fats and sugars and less in fibre has replaced our traditional balanced diet in high income groups, along with sedentary life style exposing to the burden of NCDs.

NCDs are chronic costing to the individual as well country's economy. Obesity or overweight in children as well as adult is the major modifiable risk factor for most of the NCDs like diabetes, heart disease and cancer. It is estimated that globally, more than 1.9 billion adults are overweight and 650 million are obese, while, in India, alone more than 135 million individuals are obese. Approximately 2.8 million deaths of world are reported as a result of being overweight or obese. According to ICMR-INDIAB study 2015, prevalence rate of obesity and central obesity in India, varies from 11.8% to 31.3% and 16.9%-36.3% respectively. The prevalence of obesity in India varies due to age, gender, geographical environment, socio-economic status, etc. Abdominal obesity is one of the major risk factors for cardiovascular disease (CVDs). Cardiovascular

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diseases have now become the leading cause of mortality in India. A quarter of all mortality is attributable to CVD. Ischemic heart disease and stroke are the predominant causes and are responsible for >80% of CVD deaths. The Global Burden of Disease study estimate of age-standardized CVD death rate of 272 per 100 000 population in India is higher than the global average of 235 per 100 000 population. The major NCD that threatens Indians, causing silent death is diabetes. India currently represents 49 percent of the world's diabetes burden, with an estimated 72 million cases in 2017, a figure expected to almost double to 134 million by 2025.

WHO press release in September 2018, reports that the global cancer burden is estimated to have risen to 18.1 million new cases and 9.6 million deaths in 2018. As per the Indian Council of Medical Research (ICMR) data, India had 14 lakh cancer patients in 2016 and this number is expected to increase. Also the government has laid down four priority cancers - breast cancer, cervical cancer, oral cancer, and lung cancer which together constitute 41 per cent of cancer burden. Oral Cancer is among the top three cancers in India, number one among all cancers in men and number three among female cancers, wherein, breast cancer is currently the most common cancer among Indian women, both in terms of incidence as well as mortality, with proportional prevalence in younger age-groups being higher than the global average. It is also reported that the age standardised rate for breast cancer is approximately 25.8 per one lakh women and is expected to rise to 35 per one lakh women in 2026.

WHO states that NCDs unduly affect people in low- and middle-income countries where more than three quarters of global NCD deaths occur. The total Indian, population in 2016 was 1 324 000 000 and total deaths in 2016 was estimated to be 9 569 000, of which 63% of deaths was due to NCDs.(WHO).

Table 5.1: Proportional Mortality Due To NCDs

Disease	Percentage Mortality
Cardiovascular Diseases	27%
Cancers	9%
Communicable, Maternal, Perinatal And Nutritional Conditions	26%
Chronic Respiratory Diseases	11%
Injuries	11%
Diabetes	3%
Other NCDs	13%

Source: WHO:NonCommunicableDiseases Country Profiles, 2018.

The key facts regarding NCDs worldwide, as stated by WHO is summarized below:

- NCDs are caused by unplanned urbanization, globalization of unhealthy lifestyles and population ageing. Unhealthy diets, lack

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of physical activity, use of tobacco and smoking may show up in people as raised blood pressure, increased blood glucose, elevated blood lipids and obesity. These are called metabolic risk factors that can lead to cardiovascular disease, diabetes, cancer and renal disorders.

- Non Communicable Diseases kill 41 million people each year, equivalent to 71% of all deaths globally.
- Each year, 15 million people die from a NCD between the ages of 30 and 69 years; over 85% of these "premature" deaths occur in low and middle income countries.
- Cardiovascular diseases account for most NCD deaths, or 17.9 million people annually, followed by cancers (9.0 million), respiratory diseases (3.9million), and diabetes (1.6 million).
- These 4 groups of diseases account for over 80% of all premature NCD deaths.
- Detection, screening and treatment of NCDs, as well as palliative care, are key components of the response to NCDs.

5.3 COMMON NUTRITIONAL PROBLEMS

Bone and mineral metabolism constitute a serious national health problem. Consequential disorders of nutrition are the syndromes of bone disease and deformities. Vitamin D deficiency, osteomalacia and rickets as a result of inadequate exposure to sunlight (290-315 nm), diet deficit in calcium (<300 mg/day) and fluoride interaction syndromes, calcium deficiency induced osteoporosis and calcium and vitamin D deficiency induced osteoporosis in the elderly, are the commonest disorders responsible for bone disease and deformities, besides caused by endemic skeletal fluorosis as a single entity in endemic fluorosis areas. Only mothers with severely depleted bone mineral and vitamin D stores gave birth to their babies with congenital rickets. Vitamin D deficiency rickets in children and osteomalacia in the mothers are the commonest disorders prevalent in the rural population of India. These disorders and the syndromes of calcium deficiency and fluoride interactions are largely responsible for the morbidity and mortality in the young and promising individuals, with economic consequences.

5.3.1 Macro Minerals

Macrominerals are the solid homogenous crystalline chemical compounds that are present at levels more than 0.05% in the human body. Calcium, Phosphorus, Magnesium, Sodium and Potassium are macrominerals. Of these only the deficiency of calcium is predominant, while the deficiency of other macrominerals are less common as they are widely prevalent in foods or secreted by the human body itself. Hence we shall discuss the calcium deficiency disease alone in detail.

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5.3.1.1 Calcium

Calcium is a mineral that is required continually at all life stages. In addition to building bones and keeping them solid, calcium enables our blood to clot, our muscles to contract, and our heart to pump. About 99% of the calcium in our bodies is in our bones and teeth.

Consistently, we lose calcium through our skin, nails, hair, and sweat. Our bodies can't create its own calcium. That is the reason it's imperative to get enough calcium from the food we eat. If the calcium our body needs, is not supplied through diet, it is taken from our bones. If this continues for a longer period, then the bones become weak and easy to break. The necessities are most noteworthy during the time of development, for example, adolescence, during pregnancy and childhood phases especially for growth. Long haul of calcium insufficiency can prompt osteoporosis in which the bone becomes soft and there is an increased risk of fractures. Following a well-balanced eating regimen can give all the important supplements and help avert calcium inadequacy.

Functions of Calcium

Bone Formation: Calcium is an important bone mineral. About 39.9% of bone weight is calcium.

Tooth Formation: The enamel and dentin of tooth contain hydroxyapatite. The calcification of deciduous begins in gestation and completes only before they erupt at about 6 months of age. Permanent teeth calcifies between 3 months and 3 years. Hence it is understood that calcium is vital for tooth formation from gestation itself.

Growth: Since calcium is an integral part of bone it is obvious that calcium is required for growth.

Blood Clotting: The conversion of prothrombin to thrombin, an important step in blood clotting requires the presence of calcium ions.

Contraction of Muscle: The free calcium ions bind to troponin molecules at the neuro muscular junction that triggers to shortening of myofibrils and helps in the contraction of muscles.

Intracellular Messenger: Calcium acts as a second messenger for certain hormones to exert their action. Eg: epinephrine in liver glycogenolysis. The cell to cell communication requires calcium as calcium is involved in cell contact and adhesion of cells in tissues.

Release of Hormones: Calcium facilitates release of hormones like insulin parathyroid hormone and calcitonin from the endocrine glands.

Action on Heart: Calcium ions act on myocardium and prolongs systole.

Enzyme Action: Activation of enzymes such as lipase, ATPase, succinate,

dehydrogenase and phosphorylase requires calcium.

Others: Membrane integrity and cell permeability is influenced by calcium ions. Calcium is also involved in absorption of vitamin B12. Calcium also initiates the release of neurotransmitters in the nervous system.

Calcium Deficiency Disease

Calcium deficiency is a condition wherein the body has an insufficient measure of calcium. As known, calcium is a mineral that is fundamental for all vital functions and hence it must be ingested day by day and consumed viably so as to keep up ideal wellbeing. High dietary calcium admission is crucial for newborn children, school going children and teenagers so as to advance bone development and arrangement. Pregnant ladies additionally have higher calcium needs, since it is required for the development of fetal bones. What's more, ladies who have achieved menopause need to guarantee a satisfactory measure of calcium admission to lessen the danger of osteoporosis and osteomalacia.

Osteoporosis

Osteoporosis is a major public health problem, characterized by excessive skeletal fragility and susceptibility to low-trauma fracture among the elderly. This excessive skeletal fragility is attributable to intrinsic skeletal factors such as low bone mass, unfavorable geometry at cortical bone sites, poor bone structure at cancellous bone sites. Around 60 million Indian population is affected by osteoporosis, the condition in which bone density and bone mass is reduced particularly in middle aged and elderly women, increasing the risk of bone fractures. It is not a primary deficiency disease, occurs in the menopause stage where the composition of bone remains the same, while the quantity of the bone decreases, but fully mineralised. Due to lack of oestrogen, resorption is more and associated with episodes of fracture that heals normally, and skeletal deformity occurs when there is fracture. Loss of bone density is usually marked in spine. Muscle weakness is absent. Looser's zone which is a characteristic of osteomalacia is absent in osteoporosis. The biochemical investigations reveal that in osteoporosis the plasma calcium and phosphorus are normal, plasma alkaline phosphatase levels are also normal and urinary calcium levels are either normal or high. Patients do not respond to treatment with vitamin D, while oestrogen and calcium therapy project a chance for improvement.

Aetiology

Causative factors like race, sex, body frame and heredity are non-modifiable, which are discussed below:

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- **Ethnicity:** While osteoporosis happens in individuals from every single ethnic gathering, European or Asian lineage rises risk for osteoporosis.
- **Age:** Calcium absorption is decreased in old age, associated with immobility, vitamin D deficiency and hyper parathyroidism increases the risk of osteoporosis and fracture.
- **Gender:** Women of menopausal age are more susceptible to osteoporosis due to decline in estrogen hormone levels. (Estrogen promotes osteoblast proliferation). Early menopause/hysterectomy is another predisposing factor. It is estimated that over 55% of the women belonging to low socio economic group and above 40 years of age had bone fractures endorsing the early onset of osteoporosis.
- **Stature:** Smallboned people have less dense bones and hence thin women are liable for hip fracture. The presence of fat helps to produce estrogen and reduces the risk of osteoporosis. Similarly, maternal nutrition and intra uterine growth influence birth size, birth weight, weight in infancy and childhood which are all associated with adult bone mass and osteoporosis.
- **Heredity:** Family history of osteoporosis increases the risk.
- **Other Disorders:** Malfunctioning of thyroid gland, parathyroid gland affects the calcium balance of blood plasma, while G.I and liver disorders interfere the absorption and utilisation of calcium required for bone remodelling, Renal diseases increases acidity and level of phosphate in blood which leads to bone damage. Adreno cortical hormones cause protein catabolism and thus osteoporosis when secreted in excess. Fluorosis also cause osteoporosis, if not balanced with high calcium diet. Other conditions like gastrectomy, arthritis, and immobilisation can also cause osteoporosis.
- **Drugs:** Anticonvulsants, steroids and thyroid hormones used as drugs accelerate the loss of bone mass and density leading to osteoporosis.

Certain risk factors that leads to osteoporosis are associated with life style and dietary habits which can be modified are listed below:

- **Sedentary lifestyle:** In adult, bone being inactive promotes the activity of cells that resorb bone (osteoclasts), which is a response to disuse. Also, immobility or prolonged bed rest rapidly leads to hypercalcuria, negative calcium balance, and bone loss all progressing to osteoporosis. An approximate of 0.5% of bone in a month may be lost and the ability to replace it is very less.
- **Stress:** The stress hormone adrenaline increases the breakdown of bone tissue and unless a calcium rich diet is provided for bone tissue formation, causes osteoporosis.
- **Inadequate and inappropriate diet:** Lack of calcium in the diet, lack of vitamin D, high fibre diet, excessive consumption of meat (more than 180g/ day), excess intake of carbonated beverages and salt hinders the absorption of

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calcium leading to calcium imbalance. Oxalate in spinach and phytates from whole grain cereals, combine with calcium to form insoluble complexes making calcium unavailable for absorption. Either high fat diet or malabsorbed fat ensuing steatorrhea, promotes formation of insoluble salts of fatty acids combined with calcium resulting in reduction of calcium absorption. For patients on Total Parenteral Nutrition supplementation of phosphorus helps to prevent urinary calcium loss and maintain bone matrix.

- **Alcohol:** Alcoholic drinks interfere with the absorption of calcium and vitamin D and hence cause osteoporosis.
- **Smoking:** Studies have proved that smokers are at risk of osteoporosis than non-smokers. Smokers have less body fat and this impacts the oestrogen production and osteoporosis.
- **Caffeine:** Caffeine increases urinary calcium and interferes with bone remodeling, amplifying the risk of osteoporosis. Consuming more than 3 1/2 cups of coffee or seven cups of tea surges the threat of osteoporosis.
- **Salt:** High intake of salt (3to 6gms) by a postmenopausal women, in long run would expose to osteoporosis as skeletal calcium would be mobilized (7.5% to 10%).
- **Increased G.I. motility:** Diarrhoeacauses rapid gastric emptying, reducing the time available for calcium absorption.

Manifestations

SIGN NO.1: MUSCLE CRAMPING

One of the primary indications of calcium insufficiency is an apprehensive distress called tetany, which is characterized by intermittent muscular spasms of the hands and feet essentially the wrist and metacarpophalangeal joints are flexed and interphalangeal joints extended, cramps, and muscle twitching, involuntary muscle contraction and seizures. Muscle cramping particularly in legs, can be an early sign of calcium lack. The larynx is affected posing a harsh and coarse sound. Paresthesia of face, lips, tongue, fingers and feet is a common feature.

SIGN NO.2: DRY SKIN AND BRITTLE NAILS

A typical calcium inadequacy sign can be found in skin and nails. At the point when the skin becomes dry and fingernails become weak and break easily it could be due to calcium deficiency. If these indications are seen along with yellowing of teeth it, can be seriously influenced from an absence of calcium.

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SIGN NO.3: INCREASED PMS SYMPTOMS

A women may with calcium inadequacy may experience severe fatigue, cramping, bloating and poorer concentration as premenstrual syndrome. Adding more calcium to an eating routine may ease these side effects.

SIGN NO.4: BONE FRACTURES OR BREAKAGE

Bones become porous and delicate. Calcium insufficiency also prompt spasms, joint annoyances, palpitations of heart, increased cholesterol levels, change in heartbeat rates, sleep disturbances, weakened development or functioning of nerves, muscle issues, nails, skin inflammation and numbness of the arms and additionally legs. Calcium insufficiency along with absence of vitamin D or strange groupings of hormones that control the accessibility of calcium from the blood pool intensify the symptoms.

Loss of height: Compression fractures in the spine can cause a loss of height. This is one of the most noticeable symptoms of osteoporosis.

Fracture from a fall: A fracture is one of the most common signs of fragile bones. Fractures can occur with a fall or a minor movement such as stepping off a curb. Some osteoporosis fractures can even be triggered by a strong sneeze or cough.

Back or neck pain: Osteoporosis can cause compression fractures of the spine. These fractures can be very painful because the collapsed vertebrae may pinch the nerves that radiate out from the spinal cord. The pain symptoms can range from minor tenderness to debilitating pain.

Stooped posture or compression fracture: The compression of the vertebrae may also cause a slight curving of the upper back. A stooped back is known as kyphosis. Kyphosis can cause back and neck pain and even affect breathing due to extra pressure on the airway and limited expansion of the lungs.

Diagnosis

The normal blood calcium level is 8.6 to 10.3 mg/dL. Levels below 8.6mg/dl indicates hypocalcemia. The typical value for serum albumin in blood is 3.4 to 5.4 grams per deciliter. Low levels of albumin is an indicator for low calcium levels. The reference range for Parathormone (PTH) is 10-65 pg/mL or 10-65 ng/L. Low PTH levels indicate calcium deficiency. Vitamin D level of 20 ng/mL to 50 ng/mL is considered adequate for healthy people. A level less than 12 ng/mL indicates vitamin D deficiency and in turn susceptibility to calcium deficiency. Bone mineral density (amount and quality of bone) is measured using Dual energy X-ray Absorptiometer (DEXA).

Prevention

Daily calcium intake as per the Recommended Dietary allowances will prevent calcium deficiency. The factors which promote calcium absorption along with required intake are:

- Dairy foods like milk, curds, butter and cheese are rich sources of calcium. Presence of lactose, vitamin D, ratio of calcium and phosphorus (1.2:1) makes dairy foods as best available sources

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of calcium.

- Non-dairy foods like fish, gingelly seeds, ragi, GLV like amaranth, fenugreek and drumstick leaves are also rich sources of calcium. But the calcium is not in available form.
- The transport of calcium is augmented by calcium binding protein, which requires the active form of vitamin D, 1-25 dihydroxy cholecalciferol, for its synthesis. Thus vitamin D helps to prevent calcium deficiency.
- Fruits and vegetablesexertprotective effects on bone health, as along with calcium, other nutrients like magnesium, potassium, vitamin C, vitamin K, carotenoids and B complex group of vitamins are needed to maintain bone health.
- Phytoestrogen genistein in soy has effects similar to oestrogen and protect against osteoporosis, by stimulating osteoblasts.
- If thecalcium intake is 800-1400 mg/day increased dietary protein favourscalcium absorption.
- Increase in acidity of the digestive mass increases the efficiency of calcium absorption.
- Exercise helps to increase lumbar and spinal bone mineral density, decrease the femoral bone loss consequently strengthening the bones by increasing the blood supply to joints and bones. Resistance training like running, walking, badminton, weight lifting, stretching, sit ups and aerobic exercise expose bone to varying loads and rates of strain and strengthen the muscles against resistance in a controlled manner. Improved muscle strength enhances coordination and balance and protects against falls and fractures.

Table 5.2 Recommended Dietary Allowances of Calcium

Group	Calcium mg/day
Adult (Man & Woman)	600
Pregnancy	1200
Lactation	1200
Infants	500
Children 1-9 years	600
Boys & Girls 10-17 years	800

Source: ICMR

Treatment

Hormone Replacement Therapies with calcitonin inhibits the reabsorption of calcium into the blood supply and estrogen slows the rate of bone loss, increases the synthesis of parathyroid hormone and Vitamin D synthesis, thus improving intestinal absorption and renal reabsorption of calcium, but does not stimulate new bone formation. Antiresorptive agents like bisphosphonates (like alendronate, risedronate, ibandronate, zoledronic acid)also provide effective treatment by preventing bone breakdown and increasing bone density.

5.3.1.2 Summary of Other Macrominerals

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Macrominerals phosphorus, magnesium, sodium and potassium are required for normal body functioning, although their deficiency conditions are rarely seen. The table below gives a bird's eye view of these minerals.

Table 5.3: Summary of Macrominerals

Mineral	Function	Deficiency	Food Sources
Phosphorus	Facilitates energy transactions, absorption and transport of nutrients, regulation of protein activity, acid base balance and component of essential body compounds.	Osteomalacia, myopathy, growth failure, defects in leucocyte function.	Meat, fish, poultry, eggs, dairy foods, nuts, soya, cereals like rice. RDA- 600-800 mg/day
Magnesium	Integral part of bone along with calcium and phosphorus, maintains electrical potential in nerves and muscle membrane.	Cognitive impairment- Alzheimer's disease, neuromuscular dysfunction.	Widely distributed in foods. Legumes, cereals, animal products form major sources. RDA-250-350 mg/day
Sodium	Major cation in ECF, water and acidbase balance, cell membrane permeability, glucose absorption.	Hyponatremia- altered personality, lethargy and confusion	Common table salt- processed foods, GLV. RDA-6g/ day
Potassium	Major cation in ICF, water and acidbase balance, heart muscle action, glycogen formation and protein synthesis.	Hypokalemia- weakness and fatigue, muscle cramps, aches and stiffness, tingles and numbness, heart palpitations, breathing difficulties, digestive disorders and mood changes.	Fruits, vegetables, nuts, whole grains, meat. RDA- 2000mg/day

Chlorine and Sulphur are also macrominerals involved in normal metabolic

processes, as they are widely distributed in foods of common consumption like salt, cereals, egg, legumes and meat products deficiency conditions are very rare.

Check Your Progress

- 1. Write a short note on the prevalence of malnutrition in India.**
- 2. How to treat calcium deficiency?**

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5.3.2 Micro Minerals

The minerals present at less than 0.05% levels in human body are known as micro minerals or trace minerals. Iron, Iodine, Zinc, Copper, Fluorine, Selenium, Chromium, Manganese, Cobalt and Molybdenum are some of the micro minerals in human body. Of the above listed, iron and iodine deficiency disorders are more common and manifests as anaemia and goitre has been discussed in detail in Unit-IV. The other microminerals of health significance and deficiency prevalence are zinc, and fluorine, while other micromineral deficiencies occur rarely. The prevalence, manifestations, and preventive measures are highlighted below.

5.3.2.1 Zinc

Zinc is chiefly found in bones and muscle and also bound to metalloenzymes of cells and membranes. Cells, tissues, organs, fluids and secretions also contain zinc.

Functions

- Zinc is required for the activity of more than 300 enzymes, covering all six classes of enzymes.
- Normal growth and development, epithelial tissue maintenance and reproduction are dependent on zinc.
- Zinc is needed for maturation and function of brain.
- Involved in carbohydrate metabolism. Influences the uptake of glucose by cells of adipose tissue.
- Maintenance of protein structure, replication of DNA and RNA and metabolism of protein and nucleic acids.
- Required for cholesterol transport and maintains stability of lipids within cell membrane.
- Maintains healthy appetite, assists in perception of taste and night vision.
- Involved in the synthesis of long chain fatty acids and prostaglandins.
- Zinc is acknowledged as an antioxidant nutrient.

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Zinc deficiency

Prevalence: Zinc deficiency is a significant public health problem in developing countries. It is estimated that globally zinc deficiency kills 1.5 million children every year. The studies done by International Zinc Association, reveals that 2 billion people are deficient in zinc and 800,000 people are at risk of dying each year due to zinc deficiency. In a survey conducted in five Indian states to establish the prevalence of zinc deficiency in children below the age of 5 years, the overall prevalence was found to be 43.8%, especially from children of low socio-economic group. The prevalence of zinc deficiency was highest in Orissa (51.3%), followed by Uttar Pradesh (48.1%), Gujarat (44.2%), Madhya Pradesh (38.9%) and Karnataka (36.2%). Though all age groups of the population are at risk of zinc deficiency but infants and young children, pregnant and lactating women are the most vulnerable.

Aetiology

In India mild to moderate deficiency of zinc widely prevalent can be attributed to cereal pulse based diets low in zinc and high in phytates. Some other predisposing factors are malabsorption syndromes, chronic renal disease, hepatitis, chronic blood loss, burns and excessive sweating.

Premature babies and PEM children are susceptible to zinc deficiency. Parenteral nutrition for an extended period of time causes zinc deficiency.

Rare genetic disorders like Acrodermatitis enteropathica and Sickle cell anaemia, impair zinc absorption causing severe zinc deficiency.

Manifestations

- In case of severe zinc deficiency bullous pustular dermatitis, hair loss (alopecia), diarrhoea, delayed sexual maturation, impotence, hypogonadism in males can be observed.
- Weight loss, delayed healing of wounds, taste abnormalities (hypogeusia), smell abnormalities (hyposomia) and mental lethargy are also related to zinc deficiency.
- Impairs embryogenesis, cell differentiation and causes teratology in all tissues.
- In children zinc deficiency weakens the immune system making them prone to diarrhoea, pneumonia and malaria which are most common causes of death in developing countries that includes India.

Diagnosis

Plasma zinc is the common parameter used to assess zinc status. Normal zinc plasma levels in children and adult are 8.9mcg/dl and 96mcg/dl respectively. Assay of zinc in lymphocytes, granulocytes, platelets, hair and saliva can also be used.

Prevention

Dietary zinc meeting RDA is the primary preventive measure. Zinc from animal sources like beef, pork, organ meat, poultry, sea foods, eggs and dairy products range from 1.5 to 6 mg/100mg are readily absorbed, while zinc in cereals, pulses and vegetables range from 2-4 mg/100g but poorly absorbed.

Table 5.4 Recommended Dietary Allowances of Zinc

Group	Zinc mg/day
Adult man	12
Adult woman	10
Pregnancy	12
Lactation	12
Children 1-3 years	5
4-6 years	7
7-9 years	8
Boys & Girls 10-12 years	9
Boys & Girls 13-15 years	11
Boys & Girls 16-17 years	12

Source: ICMR

Treatment

Zinc supplementation at two to three times the RDA for mild deficiency conditions whereas for moderate to severe deficiency four to five times the RDA for six months as drops, salts or tablets will prove effective.

Having discussed about the deficiency of zinc, which has public health significance, another disease Fluorosis, because of mineral fluorine is also of considerable significance. But, the difference is fluorosis is caused due to fluorine toxicity. We shall study about it in detail.

5.3.2.2 Fluorosis

Fluorine is an essential element of bones, teeth, thyroid gland and skin. Fluorine occurs as fluoride in nature at varying concentrations in soils, water supplies, plants and animals and is a constituent of all diets.

Prevalence

Fluorine toxicity has been reported from certain parts of India, China, South Africa and Tanzania. The Indian ministry of Health & Family Welfare has identified that 11.7 million Indian population (2014) are at the risk of fluorosis due to lack of clean drinking water. It has also estimated that 230 districts in 20 states severely affected by high fluoride content in drinking water, a leading cause of fluorosis. Rajasthan, Gujarat and Andhra Pradesh are worst affected states. Punjab, Haryana, Madhya Pradesh and Maharashtra are moderately affected states while Tamil Nadu, West Bengal, Uttar Pradesh, Bihar and Assam are mildly affected

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states. Tamil Nadu has high fluoride and prevalence of fluorosis in the districts of Krishnagiri, Dharmapuri, Salem and Vellore.

Functions of Fluorine

It is obvious that traces of fluorine in the teeth help to protect them against decay. Fluoride imparts stability to bone and enamel tissue due to formation of highly insoluble fluoroapatite from hydroxyapatite and hence recommended for preventing dental caries and osteoporotic fractures in elders. To prevent dental caries water should contain >1 ppm of fluoride ions, so as to inhibit the activity of oral bacteria.

Sources

Primary source of fluorine is usually drinking water, which if it contains 1 part per million (ppm) of fluoride, supplies 1-2 mg/day. Soft water contains no fluorine, while hard water may contain over 10ppm. Food sources include sea fish with large amounts of the fluorine in order of 5 to 10 ppm. Fluoride content of tea ranges between 110 mg/g to 140 mg/g of dry tea powder. (NIN)

Other sources embrace the use of fluoridated tooth paste, mouth wash and teflon coated pans. Fluoride containing fertilizers, aluminum smelting nuclear power plants, electric power industry, and petroleum refining industry in addition to automobile industry emits fluoride into the environment, thus finding its way into sea water, surface water, underground water and vegetation.

Manifestation of Fluorosis

Fluorine toxicity manifests as skeletal and dental fluorosis.

Skeletal fluorosis: Slow progression of fluorosis leads to stiffness, joint pain and deformities of the spine. When fluoride intake was higher than 2-16 mg/litre causes 'genuvalgum' (knock knees) especially in young and adolescent boys. Along with fluorine, high levels of Mo and low level of Cu might also contribute to genuvalgum.

Dental fluorosis: Dental fluorosis is not usually associated with any evidence of skeletal fluorosis or indeed with an impairment of health. Irreversible mottling of permanent teeth is common if the fluoride content of the water is high (> 3-55 ppm). The enamel loses its luster and becomes rough. Bands of brown pigmentation separate patches as white as chalk. Incisors of the upper jaw are more affected.

High fluoride intakes also interfere with iodine metabolism, causing hypothyroidism and also leads to vitamin D deficiency causing bone deformities in young children, as interferes with parathyroid and growth hormone levels.

Diagnosis

The assessment of fluoride in blood, urine and drinking water along with

haemoglobin and forearm X-ray provides useful diagnostic indices.

Prevention

Measures to prevent fluorosis has been framed by NIN, is listed below.

- Health education and awareness to the community to discourage the use of water for drinking from high fluoride sources (should be less <2 ppm).
- Administrators should be sensitized regarding the need for identifying water sources with permissible levels of fluoride to provide safe drinking water.
- Children and adolescents from endemic areas should be supplemented with therapeutic doses of micronutrients such as calcium, vitamin D and vitamin C to decrease the consequences of fluorosis.
- Defluoridation is the most economic and feasible choice of supply of fluoride free water and should be encouraged among masses. Defluoridation technique of removing fluorine from water using aluminium salts was developed by NEERI.
- Tea, tobacco and use of fluoride rich tooth paste should be avoided.
- Encourage the consumption of foods rich in calcium, vitamin C and protein.
- Urinary excretion of fluoride is enhanced by tamarind consumption, thereby delaying the progression of fluorosis.

5.3.2.3 Summary of Other Microminerals

Other micronutrient deficiencies of less common incidences are tabulated below.

Table 5.5: Summary of Microminerals

Mineral	Function	Deficiency	Food Sources
Manganese	Enzyme component in metabolism	Impaired growth, reproductive function, glucose tolerance, skeletal abnormalities, and altered carbohydrate and lipid metabolism	Cereals, whole legumes, leafy vegetables RDA- 2-5mg/day
Cobalt	Constituent of Vitamin B12,	Associated with B12	Meat, liver, kidneys,

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	improves insulin function.	deficiency.	milk, oysters, mussels, fish, shellfish. RDA-5-8 mcg /day
Selenium	Constituent of glutathione peroxidase, antioxidant, component of teeth.	Keshan-Beck disease of cartilage in adolescence.	Cereals, millets, sea foods, dairy products, low fat meat. RDA-400mcg /day
Molybdenum	Constituent of xanthine oxidase	Unknown	Whole grains, legumes, milk, organ meat, leafy vegetables

Source: B.Srilakshmi, Nutrition Science

Check Your Progress

- 3. Mention the RDA and sources of zinc.**
- 4. List the functions of fluorine.**

5.3.3 Fat Soluble Vitamins

Vitamin A, D, E and K are fat soluble vitamins. Vitamin A and Vitamin D deficiency diseases are of community significance and sufficient knowledge on Vitamin A deficiency is already assimilated from the previous unit. Now let us discuss about the vitamin D deficiency disease condition.

5.3.3.1 Vitamin D

Vitamin D is available as vitamin D₂ (ergocalciferol) and vitamin D₃ (1-25 dihydroxy cholecalciferol). The naturally occurring and biologically important form of vitamin D that is synthesized in the skin from endogenous or dietary cholesterol upon exposure to sunlight is Cholecalciferol or vitamin D₃. The ergocalciferol form or vitamin D₂ is often used as a food additive.

Functions

- The major function of vitamin D is to maintain normal blood levels of calcium and phosphorus. Hence calcium and Vitamin D functions and deficiencies are synergistic.
- Favours the absorption of calcium, helping to form and maintain strong bones, preventing osteoporosis, hypertension, cancer, and several autoimmune diseases.
- Vitamin D triggers the body's immune cells to produce

antibodies and promotes an overall increase in the strength of the immune system.

- Vitamin D assists in the maintenance of joint and muscle comfort, as well as the maintenance of a healthy mood, and supports breast, colon, and prostate health.

The functions of Vitamin D is well illustrated in the following figure.

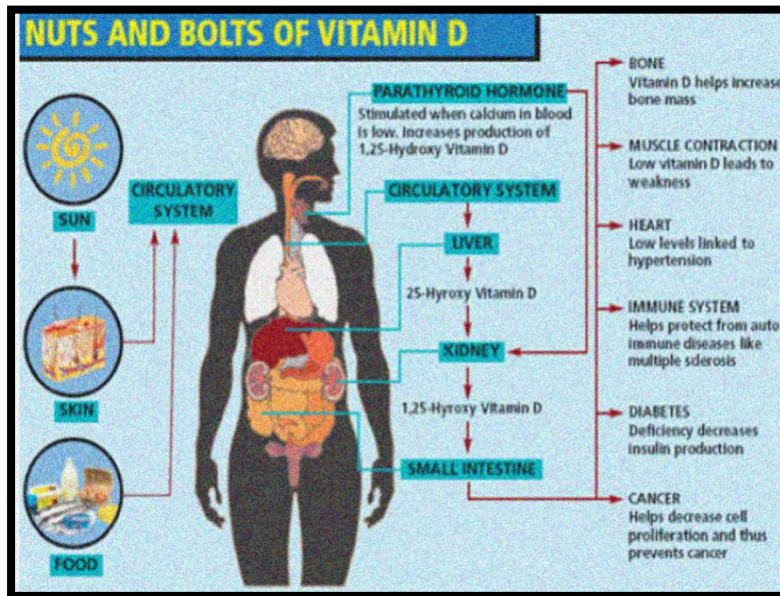


Figure 5.1 Functions of Vitamin D

Source: <https://www.downtoearth.org.in>

Vitamin D Deficiency

Prevalence

The Vitamin D deficiency is a silent epidemic grabbing attention as the prevalence ranges from 40% to 99%, with most of the studies reporting a prevalence of 80% to 90%, in all the age groups and high-risk groups alike. Skeletal diseases, autoimmune diseases, cardiovascular diseases, cancer, and tuberculosis are being explored, as a result of vitamin D deficiency. Despite the availability of vitamin D from sunlight, Indians do not meet the daily requirement of Vitamin D, hence among the public and healthcare providers awareness about the importance of Vitamin D and the consequences of deficiency should be promoted.

Aetiology

- Vitamin D otherwise called sunshine vitamin, defines itself that the source of vitamin D is sun. So, people who do not expose themselves to sunlight are prone for vitamin D deficiency. Use of sunscreen, living close to Polar Regions, darker skin pigmentation, high levels of air pollution decrease the utilisation of sunlight.
- Natural food sources of vitamin D are animal-based, including fish and fish oils, egg yolks, fortified milk, butter, cheese and beef liver hence vegans are prone for vitamin D deficiency.
- Gastro Intestinal disturbances and chronic renal disorders interfere with the absorption and synthesis of vitamin D.

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- Use of corticosteroids impair the metabolism of vitamin D causing deficiency.

Manifestations: Vitamin D deficiency manifests as rickets and osteomalacia.

Rickets

Signs and symptoms of rickets include the following:

- The changes in bone are the most characteristic and easily identifiable signs of rickets.
- “Bossing” of frontal and parietal bones is seen. Delayed closure of anterior fontanelle.
- Craniotables –thinning and wasting of the cranial bones.
- Rickety Roasary or beading of the ribs - Extension, widening and enlargement of epiphyses at the lower end of the radius at costochondral junctions of the ribs is an early diagnostic feature.
- Pigeon chest –prominence of sternum is a common feature.
- Harrison’s sulcus–sucking in of the softened ribs on inspiration during whooping cough or other respiratory infections.
- Lower end of the femur, tibia and fibula enlarges.
- Kyphosis – Hunch back of spine develops when the child sits and crawls due to the gravitational and muscular strains on the bones.
- When the child starts to walk deformities of the shafts of leg bones develop “knock knees” genuvalgum or “bow legs” genuvarum.
- At later stages kyphosis is replaced by lordosis.
- Other manifestations include restlessness, excess sweating on head and distended abdomen, respiratory infections, delayed mile stones, G.I problems like diarrhoea are frequently seen.

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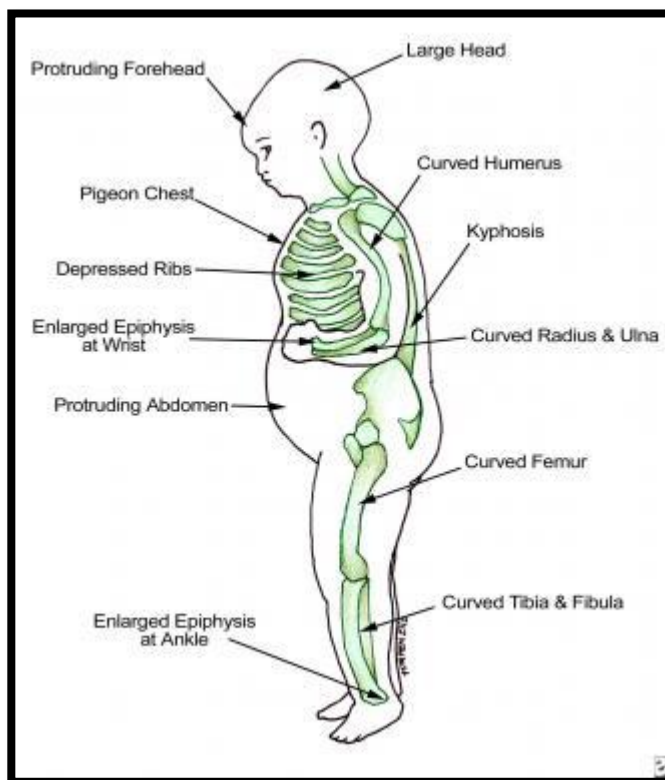


Figure 5.2 Signs and Symptoms of Rickets
Source: *emedicine.medscape*

Osteomalacia

- Softening of bone due to vitamin D deficiency and failure to replace the turnover of calcium and phosphorus in bone is osteomalacia.
- Bone is demineralised and hard bones are replaced by soft osteoid tissues and loss of bone density is widespread.
- Fractures are uncommon and if occurs healing is delayed.
- Skeletal deformity especially kyphosis is noted where bending and softening of spinal bone occurs.
- Ribs, sacrum, lower lumbar vertebrae, pelvis and legs experience dull ache to severe pain.
- Muscular weakness is a common feature, producing disability and when severe characteristic gait is seen.
- Looser's zone – Rarefaction of bone and translucent bands at ribs, axillary borders of scapula, pubi rami and medial cortex of upper femur are diagnostics of osteomalacia.
- Plasma calcium and phosphorus and urinary calcium levels are often low, while plasma alkaline phosphatase level is high.
- Osteomalacia shows a dramatic response to treatment with vitamin D, while treatment with oestrogen and calcium have no role.

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Diagnosis

25-hydroxy vitamin D blood test is an indicator for vitamin D status. A level of 20 ng/mL to 50 ng/mL is considered adequate for healthy adult people. For infants 10-40ng/mL is normal. A level less than 12 ng/mL in adults and 9 ng/mL in infants indicates vitamin D deficiency.

Radiograph of the wrist shows characteristic changes such as blurred and hazy joints and broadened epiphyseal line at epiphyses in infants. In older children, radiographic examination shows classic concave saucer deformity as a result of decalcification of the metaphysis.

Prevention

Vitamin D intake is recommended at 400–800 IU/day, or 10–20 micrograms to prevent vitamin D deficiency. Inclusion of foods rich in vitamin D and exposure to sunlight play a major role in vitamin D deficiency prevention. Calcium intake should also meet the RDA to prevent rickets and osteomalacia.

Treatment

A daily oral dose of 25-125mcg (1000-5000 IU/ day) is recommended to treat rickets and osteomalacia. On convalescence the dose should be reduced to 10mcg to avoid toxicity. 1ml of halibut fish oil is recommended for children.

As the deficiency of vitamin E and vitamin K is not commonly prevalent we shall move on to the commonly widespread nutritional deficiencies of water soluble vitamins.

5.3.4 Water Soluble Vitamins

Of the water soluble vitamin deficiency the most common are niacin deficiency, folate deficiency, vitamin B12 deficiency and vitamin C deficiency diseases, though the incidence of these deficiencies are also markedly reduced.

5.3.4.1 Niacin

Niacin also known as nicotine or vitamin B3 plays a vital role in metabolism of carbohydrate, protein and lipid by releasing energy. Niacin forms a part of co-enzymes NAD (Nicotinamide Adenine Dinucleotide) and NADP (Nicotinamide Adenine Dinucleotide Phosphate).

Pellagra

The deficiency of niacin or essential amino acid tryptophan(interrelated, 60mg of tryptophan can be converted to 1 mg niacin) in the diet leads to pellagra. Pellagra, once a common disease is becoming increasingly rare, though still endemic among the maize eating populations of India. Pellagra manifests with general symptoms like weakness, weight loss, debility, loss

of appetite, nausea, G.I disturbances, anxiety and sleep apnea. Specific manifestations of pellagra are Diarrhoea, Dermatitis, Dementia and Death, hence called as disease of 4D's. Let us discuss the signs and symptoms in detail.

Gastrointestinal changes: The G.I disturbances are mainly due to the inflammation of mucous membrane, resulting in severe glossitis, stomatitis, esophagitis, gastritis, enteritis and finally bloody diarrhoea.

Dermatological changes: The parts exposed to sun, heat or light especially the upper and lower extremities, face and neck become hyperkeratotic and hyper pigmented. The lesions appear in the form a necklace in the neck and hence called as Casal's Necklace. In acute cases the skin lesions may progress to vesiculation cracking, exudation and crusting with ulceration and sometimes secondary infection. In chronic cases the skin roughens and thickens with a brown pigmentation. The decreased collagen content and alterations in copper metabolism contribute to skin changes.

Neurological manifestations: Serotonin or 5-hydroxy tryptamine is decreased in pellagra and is responsible for mental depression. Progressive dementia, with apprehension and confusion in early stages leads to derangement. Insomnia is also common and in later stages evident as disorientation, hallucination and delirium. The peripheral nerve may also be affected with paraesthesia and decreased nerve conduction, incoordination and tremors may occur. Spastic paraplegia has been reported. Exaggerated deep tendon reflexes are observed. Delirium is the most common mental disturbance in the acute form of the disease and dementia in the chronic form.

The final stage leads to death.

Causes: Poverty, diet rich in maize, jowar because of low niacin and tryptophan content, malabsorption and alcoholism are the common causes for pellagra.

Diagnosis: The ratio of urinary metabolites methyl-carboxamidopyridone and methyl nicotinamide less than 1 indicates underlying niacin deficiency. Urinary excretion of methyl nicotinamide less than 0.8mg/day indicates niacin deficiency.

Prevention: The prevention of pellagra is based on nutritional advice that includes avoidance of foods such as jowar, ragi, maize and alcohol and inclusion of diet rich in niacin such as eggs, bran, meat, poultry, fish, legumes and seeds. Everyday consumption of groundnuts will be effective. For every 1000kcal intake, 6.6mg of niacin is recommended.

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Treatment: Oral administration of 100 to 300 mg of nicotinic acid, along with riboflavin and pyridoxine reverts the neurological changes in 2-3 days. Dermal lesions will take 3 to 4 weeks to settle down.

5.3.4.2 Folic Acid

The term folic acid or folate is commonly used to describe any compound or mixture of compounds with the activities of pteroylmonoglutamic acid. Folate is required for the normal growth and division of cells, act as a coenzyme in reactions involving the transfer of one-carbon unit such as the methyl group from or metabolite to another as in transmethylation of homocysteine to methionine, ethanolamine to choline, phenylalanine into the amino acid tyrosine and uracil to thymine. The formation of the haeme group of haemoglobin and nucleic acid functioning requires folate.

Megaloblastic Anaemia

Folic acid deficiency manifests primarily as megaloblastic anaemia, in which the bone marrow produces unusually large, structurally abnormal, immature red blood cells.

Aetiology

- Poor dietary intake of milk, fresh fruits and vegetables leads to folic acid deficiency. Indian diet is a poor source of folic acid and cooking practices commonly encountered tend to destroy the folic acid to a considerable extent.
- Low folic acid absorption in conditions like pregnancy, diet low in vitamin C, B12, and conditions like infections and infestations, celiac disease and in tropical sprue causes folate deficiency.
- Increased requirement of folic acid during pregnancy and growth if not met causes megaloblastic anaemia.
- Anticonvulsant drugs used for treatment of epilepsy and oral contraceptives may impair folate absorption in some women.
- Chronic alcoholism also leads to folate deficiency.

Manifestations

General symptoms of anaemia like weight loss, anorexia, fatigue,

Irritability, dyspnoea, palpitation, headache and diarrhoea are observed in megaloblastic anaemia too. Glossitis and Paraesthesia are more common.

Other manifestations of folic acid deficiency include a high rate of cell division, such as intestinal cells and red blood cells. In pregnancy folate deficiency causes pregnancy induced hypertension, proteinuria and oedema. Folate deficiency during pregnancy has been firmly linked to various forms of damage to the developing foetus like neural tube defects such as spina bifida, in which the vertebral neural arches fail to close, exposing the contents of the spinal canal posteriorly and also causes

anencephaly i.e. absence of brain.

Diagnosis

Excretion of Formimino Glutamate (FIGLU) after a histidine load is an indicator of deranged metabolism of folate leading to folate deficiency. Normal adults excrete less than 35 mg FIGLU in 24 hours after 5 g histidine load, whereas in folate deficiency the levels raise to 60mg. Haemoglobin levels less than 4g/dl and plasma folate less than 3mcg/ml and presence of free hydrochloric acid in gastric juice are all indices of folate deficiency.

Prevention

Folate rich foods like pulses, green leafy vegetables, cluster beans, ladies finger, gingelly seeds, liver and eggs should be included liberally in the diet, to meet RDA will prevent folate deficiency. Supplementation with 180mg of ferrous sulphate and 0.5mg of folic acid for pregnant and nursing mothers and 60mg of ferrous sulphate and 0.1mg of folic acid for 1-5 year old children prevents anaemia.

Table 5.6 Recommended Dietary Allowances of Folate

Group	Dietary Folate mcg/day
Adult man	200
Adult woman	200
Pregnancy	500
Lactation	300
Infants	25
Children 1-3 years	80
4-6 years	100
7-9 years	120
Boys & Girls 10-12years	140
Boys & Girls 13-15years	150
Boys & Girls 16-17years	200

Source: ICMR

Treatment

Supplementation with 400-800 mcg/day of folic acid prior to conception or in early stages of conception prevents neural tube defects in foetus. For patients who have more than 5 g/dl of haemoglobin folic acid in dose of 5 to 10 mg daily is effective. Less than 5 g/dl of haemoglobin requires blood transfusion.

5.3.4.3 Vitamin B12 Deficiency

Vitamin B12 like folic acid is required for the formation of red blood cells, nucleic acids and amino acids. The absence of intrinsic factor in the G.I.

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tract that absorbs vitamin B12 leads to pernicious anaemia, a type of megaloblastic anaemia.

Aetiology

- Vegans (Pure vegetarians) are prone for vitamin B12 deficiency.
- Atrophic gastritis, thinning of stomach lining affects B12 absorption.
- Small intestine disorders such as Crohn's and celiac diseases, bacterial or parasitic infections and infestations.
- Immune disorders such as Grave's disease or lupus.
- Medications like ranitidine, pantoprazole and metformin interfere with the absorption of B12.
- Folic acid deficiency may also contribute to B12 deficiency.

Manifestations

- The haemoglobin content may be as low as 8%.
- Anorexia, growth retardation, lemon yellow or pale skin, pigmentation, abdominal discomfort, frequent diarrhoea, weight loss and general weakness can also occur.
- Glossitis, tongue surface is usually smooth and atrophic but sometimes it is red and inflamed.
- Gastric secretions are devoid of pepsin, acid and intrinsic factor and achlorhydria is a common feature. Poses an increased risk of gastric cancer.
- Numbness of limbs, coldness of extremities and difficulties in walking are manifestation of neurologic changes.
- Demyelination of white fibres of spinal cord occurs in severe cases.
- Psychiatric symptoms like mental apathy are associated with low level of vitamin B₁₂ in the plasma, but in the absence of other signs of neuropathy.
- In young females there may be infertility.

Diagnosis

- **Schilling test:** A specific test to assess B12 status ingests a tiny amount of radioactive vitamin B-12 and blood is tested to check if radioactive vitamin B-12 has been absorbed. Later, ingest a combination of radioactive vitamin B-12 and intrinsic factor. If the radioactive B-12 is absorbed only when taken with intrinsic factor, it confirms the lack of intrinsic factor and consequently vitamin B12 deficiency.
- Plasma vitamin B12 is below 160ng/l while plasma folate is normal indicates B12 deficiency.
- The normal range for vitamin B-12 in the blood is between 200 and 900 pg/mL. Levels below 200pg/mL denotes deficiency.

Prevention

Vitamin B12 is predominantly present in animal foods like liver, fish, beef, mutton, egg and milk. Certain fermented foods like curd also provide vitamin B12. Regular consumption of these as per RDA will prevent B12 deficiency.

Table 5.7 RDA of Vitamin B12

Group	Dietary Folate mcg/day
Adult man & woman	1
Pregnancy	1.2
Lactation	1.5
Infants	0.2
1-18 years	0.2-1

Source: ICMR

Treatment

A combined therapy of B12 and folic acid will be effective. In the first week of treatment 1000mcg of B12 is given intramuscularly twice, and then 250mcg weekly till the blood count returns to normal. Then 1000mcg every six weeks is given for maintenance. Usually, the reticulocyte count reverts to normal about 4th to 7th day. 200mg of ferrous sulphate thrice daily is given to cope with regeneration of blood.

5.3.4.4 Vitamin C

Vitamin C is ascorbic acid and it is also known as hexuronic acid and antiscorbutic nutrient. Vitamin C plays a major role in human metabolism ranging from the synthesis of collagen, carnitine and norepinephrine to a large number of antioxidant activities by reducing molecular oxygen. Thus, it maintains lipid profile, reduces the mortality rate from atherosclerosis, and helps maintain blood haemoglobin levels by maintaining the ferrous state and osteoblast and fibroblast function. The deficiency of vitamin C namely scurvy which is considered as a disease of 18th century is still prevalent in many developing countries. Let us now discuss in detail about scurvy.

Scurvy

Scurvy is a constellation of clinical manifestations caused by physiologic Vitamin C deficiency. The survey conducted by Ravindran et al. in 2011 has estimated the age, sex and season standardized prevalence of vitamin C deficiency was 73.9% in north India and 45.7% in south India.

Aetiology

- Humans are unable to synthesize vitamin C and are dependent on dietary sources, mainly fruit and vegetables, if not supplied through diet deficiency occurs.

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- Poor socio economic status, prevents the expenditure on fruits and vegetables.
- High use of tobacco and smoking.
- Old age.
- Faulty cooking methods as vitamin C is heat liable, exposing to high temperature cooking destroys vitamin C. Exposure of vitamin C rich fruits and vegetables to air causes oxidation and thus loss of vitamin C.
- Vitamin C cannot be stored in the body beyond 3 months and excess is excreted in urine. Hence regular supply of vitamin C is essential to prevent deficiency.
- Patients on hemodialysis, those who suffer from G.I. disorders are prone for vitamin C deficiency.

Manifestation

Scurvy manifests as

Tender bones: The legs assume the typical frog like position due to tenderness.

Petechial haemorrhages: The capillaries become brittle and burst thus giving rise to red and purple spots over the body.

Gingivitis: There is spongy swellings of the mucous membrane causing bleeding of gums.

Delayed wound healing: The failure of the cells to deposit collagen fibrils delays wound healing.

Cessation of bone growth: The bone fails to ossify and stops to grow. Other symptoms include pinpoint bleeding around hair follicles and under the nails.

Children may develop anaemia and pyrexia.

Diagnosis

Serum testing for low plasma vitamin C (less than 0.2 mg/dL) is usually consistent with scurvy. The level of vitamin C in leukocytes is more accurate when assessing the sparse vitamin C stores as they are less affected by acute dietary changes. A leukocyte vitamin C level of 0 mg/dL is indicative of latent scurvy. Zero to 7 mg/dL is consistent with deficiency, and greater than 15 mg/dl is adequate.

Prevention

Ascorbic acid occurs widely in plant foods, particularly in fresh citrus fruits and vegetables especially green leafy vegetables. Amla is the richest source of vitamin C. Guava, orange, sweet lime and lime, capsicum, drumstick leaves, agathi are good source of vitamin C. Meat, milk, cereals and pulses are poor sources of ascorbic acid.

Vitamin C in foods can be enhanced by

Consuming fruits and vegetables immediately after cutting ie. Limiting exposure to air and sunlight.

Encourage intake of fresh fruits, avoid juices.

Avoid soaking food in water, cook food in large pieces and use minimal water for cooking.

Store foods in a cool and moist place.

Harvesting at the peak of maturity. i.e. Well ripe fruits contain more vitamin C.

Vitamin C daily intake of 40 mg/day for adult and children, 60mg/day for pregnant women, 80mg/day during lactation, 25mg/day is recommended for infants by ICMR, 2010, helps prevent deficiency.

Treatment

Scurvy in infants and children is treated by giving 10-25mg vitamin C, 2-3 times a day. Spontaneous bleeding decreases within 24 hours. Muscle and bone lesions take 2-3 weeks' time to heal. Large ecchymosis heal in 10-12 days. Anaemia gets corrected within 2-4 weeks.

Check Your Progress

5. Describe the functions of vitamin D.

6. What causes Pellagra?

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5.4 ANSWERS TO CHECK YOUR PROGRESS

QUESTIONS

1. India's exhibition on key lack of malnutrition pointers is poor as per national and global investigations. As indicated by UNICEF, India was at the tenth position among nations with the most noteworthy number of underweight children, and at the seventeenth place for the most elevated number of stunted children in the world. Lack of malnutrition influences odds of survival for youngsters, builds their vulnerability to ailment, diminishes their capacity to learn, and makes them less profitable in later life. It is evaluated that malnutrition is a contributing component in around 33% of preschoolers performance lag. India's record of high economic growth over the past decade has not transformed the nutritional status of its population to the extent necessary: latest research shows that despite doubling the rate of stunting reduction in the past 10 years from the previous decade, India still has the largest share of the world's undernourished population. Among adults, 23% of women and 20% of men are viewed as undernourished in India. Then again, 21% of women and 19% of men are overweight or stout. The synchronous event of over nutrition and under-nourishment demonstrates that grown-ups in India are experiencing a double burden of malnutrition (unusual slimness and corpulence), which points to 56% of women and 61% of men.

The World Bank has declared that with 40 percent of its workforce having experienced stunting as children, India is simply not going to be able to compete in the future economy. Also, World Bank's recent report on Nutrition, says India loses over \$12 billion in GDP to vitamin and mineral deficiencies. 48% of children under the age of five years are stunted, 43 per cent are underweight, 20 per cent are wasted, and more than 1 in 4 infants are born with a low birth-weight. Indeed, the Global Hunger Index (GHI) ranked India at 103 among 119 countries in 2018, in view of the prevalent undernutrition situation. At the same

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time, overnutrition is emerging as a silent epidemic in many parts of the country, and the current healthcare delivery system is barely equipped to deal with this additional policy challenge. The Harvard TH Chan School of Public Health, US, (2018) has reported that by 2050, India will be bearing the greatest burden of having 50 million zinc deficient people, 38 million protein deficient people and 502 million iron deficient children and women, because of increasing carbon dioxide in the air which is currently making staple crops rice and wheat less nutritious.

2. Hormone Replacement Therapies with calcitonin inhibits the reabsorption of calcium into the blood supply and estrogen slows the rate of bone loss, increases the synthesis of parathyroid hormone and Vitamin D synthesis, thus improving intestinal absorption and renal reabsorption of calcium, but does not stimulate new bone formation. Antiresorptive agents like bisphosphonates (like alendronate, risedronate, ibandronate, zoledronic acid) also provide effective treatment by preventing bone breakdown and increasing bone density.
3. Zinc from animal sources like beef, pork, organ meat, poultry, sea foods, eggs and dairy products range from 1.5 to 6 mg/100mg are readily absorbed, while zinc in cereals, pulses and vegetables range from 2-4 mg/100g but poorly absorbed.

Group	Zinc mg/day
Adult man	12
Adult woman	10
Pregnancy	12
Lactation	12
Children 1-3 years	5
4-6 years	7
7-9 years	8
Boys & Girls 10-12years	9
Boys & Girls 13-15years	11
Boys & Girls 16-17years	12

4. Traces of fluorine in the teeth help to protect them against decay. Fluoride imparts stability to bone and enamel tissue due to formation of highly insoluble fluoroapatite from hydroxyapatite and hence recommended for preventing dental caries and osteoporotic fractures in elders. To prevent dental caries water should contain >1 ppm of fluoride ions, so as to inhibit the activity of oral bacteria.
5. The major function of vitamin D is to maintain normal blood levels of calcium and phosphorus. Hence calcium and Vitamin D functions and deficiencies are synergistic. Favours the absorption of calcium, helping to form and maintain strong bones, preventing osteoporosis, hypertension, cancer, and several autoimmune diseases. Vitamin D triggers the body's immune cells to produce antibodies and promotes

an overall increase in the strength of the immune system.

Vitamin D assists in the maintenance of joint and muscle comfort, as well as the maintenance of a healthy mood, and supports breast, colon, and prostate health.

6. The deficiency of niacin or essential amino acid tryptophan (interrelated, 60mg of tryptophan can be converted to 1 mg niacin) in the diet leads to pellagra. Pellagra, once a common disease is becoming increasingly rare, though still endemic among the maize eating populations of India. Pellagra manifests with general symptoms like weakness, weight loss, debility, loss of appetite, nausea, G.I disturbances, anxiety and sleep apnea. Specific manifestations of pellagra are Diarrhoea, Dermatitis, Dementia and Death, hence called as disease of 4D's.

5.5 SUMMARY

This unit has thoroughly given an understanding of the common nutritional problems that are prevalent are primarily caused due to poor diet or infections. Sedentary life style, faulty cooking practices, alcoholism also aggravate the conditions. Of the macrominerals the widely prevalent deficiency disease is osteoporosis. Zinc deficiency manifestations and fluorosis has been discussed in detail. The vitamin D deficiency conditions namely rickets and osteomalacia, pellagra as a result of niacin deficiency, megaloblastic and pernicious anemia due to folate and vitamin B12 lack and scurvy which clutches many deficiency symptoms within itself have been highlighted. Also, the non-communicable diseases are acquired due to ignorance on healthy diet and healthy life style. Hence proper health and nutrition education will lessen the burden due to NCDs.

5.6 KEY WORDS

- **Delirium:** Disordered state of mind with incoherent speech and exhilaration.
- **Palpitation:** Rapid, strong, irregular heartbeat.
- **FIGLU:** Formimino glutamic acid used in estimation of folic acid.
- **Macrocytic Anaemia:** Large and immature RBCs causing anaemia.

5.7 SELF ASSESSMENT QUESTIONS

Short Answer Questions

1. Differentiate osteoporosis and osteomalacia.
2. Write short note on rickets.
3. Explain in brief about scurvy.
4. What is fluorosis? Explain its types.

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Long Answer Questions

1. Summarize the micromineral deficiencies.
2. Elaborate the causes and deficiency conditions of calcium.
3. Explain the macromineral deficiency conditions.
4. Detail on the causes and deficiency conditions of vitamin D.
5. Sketch the prevalence and burdens of NCDs.

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UNIT – 6 STRATEGIES TO OVERCOME MALNUTRITION IN INDIA

Structure

- 6.0 Introduction
- 6.1 Objectives
- 6.2 Strategies to Overcome Malnutrition
 - 6.2.1 Measures to Sustain Nutrition and Food Security
 - 6.2.2 National Nutrition Policy Instruments
- 6.3 Integrated Approach to Solve Problems of Malnutrition
 - 6.3.1 Intergenerational Cycle of Malnutrition
 - 6.3.2 Measures to Break the Intergenerational Cycle of Malnutrition
 - 6.3.3 Need for an Integrated Approach
- 6.4 Answers to Check Your Progress Questions
- 6.5 Summary
- 6.6 Key Words
- 6.7 Self-Assessment Questions
- 6.8 Further Readings

6.0 INTRODUCTION

Now, we are very much familiar with malnutrition and terms related to malnutrition such as undernutrition, overnutrition, imbalance, specific deficiency etc. We are also aware of the fact that Asia and Africa bear the greatest share of all forms of malnutrition. In 2016, approximately, 155 million children (under 5 years) in the world were stunted, 52 million were wasted and 17 million were severely wasted, of which more than 50% of the stunted children were in Asia and more than one third lived in Africa. Women account for over 60% of the world's hungry population. FAO in the "The State of Food Security and Nutrition in the World" 2017 edition points that 190.7 million people are undernourished, while 21% children under 5 years are underweight, 38.4% children under 5 years are stunted in India. Even more heart throbbing fact is that India bears the largest undernourished population in the world. These figures illustrate the magnitude of malnutrition in India to us very well. Hence, it's high time to devise effective strategies to overcome the nutritional problems. In this unit we shall learn the consequence of malnutrition and the integrated approaches needed to solve the problems of malnutrition.

6.1 OBJECTIVES

After going through this unit you will be able to discuss,

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- The consequences of malnutrition
- The different strategies to overcome malnutrition and The need of integrated disciplines like agriculture, science and technology in combating malnutrition.

6.2 STRATEGIES TO OVERCOME MALNUTRITION

Malnutrition manifest itself in terms of illness and death in all age groups. Children, pregnant women, nursing mothers and elderly are vulnerable to the effects of malnutrition. We already know that malnutrition contributes to more than half of child death worldwide. Further, the risk of death rises with increase in the grade of malnourishment among children from mild to moderate to severely malnourished.

The main means to overcome malnutrition is to provide a balance diet, as to meet the requirements of Recommended Dietary Allowances. A complete diet inclusive of all food groups viz. cereals, pulses, nuts and oil seeds, fruits and vegetables, milk and meat products, sugars, fats and oils providing all the required nutrients namely carbohydrates, proteins, fats, vitamins and minerals along with fibre and water as per the required quantity according to the age group is an important aspect to overcome malnutrition.

Also, as studied in unit-1 ensuring food and nutrition security must be the utmost criteria to overcome malnutrition. Thus it is imperative to apply integrated strategies to overcome malnutrition.

The food and nutrition security can be attained, thus malnutrition can be eradicated by the following measures:

6.2.1 Measures to Sustain Nutrition and Food Security

1. By improving the dietary habits of people both in terms of quantity and quality, hunger and malnutrition free India can be made possible.
2. Food Security vs Nutrition Security is possible by multisectoral convergence of government programmes, policymakers, plan administrators, field level agents, farmers and consumers, professionals and people in general together in synergy.
3. Food and Nutrition Security awareness, availability of food (inclusive of pulses, millets, fruits, vegetables, milk and so on) and access of food at affordable cost at household and individual level are of foremost important.
4. Continuance of Second Green Revolution direction should be nutrition oriented approach.
5. Strengthening, evaluation and close monitoring of all nutrition oriented government schemes and programmes to ensure food availability, accessibility and utilization must be prioritized.
6. School children, youth, pregnant and lactating women must sensitized more about nutritive value of food and its importance.

7. Popularization, promotion and usage of small millets in the regular diets.
8. Connecting between production system and processing industries in urban and market to consumer is very much essential to accessibility.
9. Government should implement and propagate National Millet Mission by introducing high yielding dry land millet seed varieties, technical support and research, establishing small millet markets in production areas and purchase of millets by way of Minimum support price and should initiate steps for millet distribution through Public Distribution System.
10. The ongoing nutrient supplementation programmes like Vitamin A tablets distribution, iron folic acid tablet supplementation for vulnerable people like pregnant and lactating women and female adolescent children should be strengthened on par with pulse polio vaccine programme.
11. Food security strategies should address the causes and effects of food insecurity. Therefore, any food security strategy places a significant focus on the following integrated issues:
 - **Enhancing agricultural productivity:** Agriculture is considered to be the starting point for initiating the structural transformation of the economy. Increase in agricultural production and productivity in proportion with population growth. Augmenting increase in income of farmers. Promotion of Organic farming for getting higher income to the farmers. Establishment of more agricultural producers firm and societies for issuance of more benefits to farmers to reduce the production costs. Urban agriculture can also be promoted.
 - **Environmental rehabilitation and sustainability:** This is critical to the pursuit of food security and economic development generally. Development depends on the appropriate and sustainable use of the environment and the management of natural resources. Measures to reverse the level of land degradation and create a source of income generation for food-insecure households through a focus on biological measures, such as re-forestation and land preservation. Focus on agriculture backward rural areas, tribal areas and areas affected by natural calamities should be continuously monitored for sustenance of agriculture. Poverty and Food insecurity is greater in dry land areas. So employment and nutrition oriented programmes must be highly focused in these areas.
 - **Water projects:** Water harvesting and the introduction of high-value crops, livestock and agro-forestry development. Precise water management by promotion of drip irrigation, improving soil fertility, rainwater harvesting in rain fed areas can be strengthened.

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- **Establishment of more commodity specific groups:** Establishment of commodity cluster areas and providing sufficient infrastructure, example: orange plantation cluster in TamilNadu, red chillies cluster in Guntur in Telangana state, etc.

- **Controlling population growth:** High population growth rates continue to undermine many developing countries' ability to be food secure and provide effective education, health and other essential social and economic services. The central elements of the policy focus on a multi-sector approach, improving family planning services and expanding education.

- **Prevention and control of HIV/AIDS:** HIV/AIDS is a formidable challenge to the pursuit of food security in many countries as it reduces and debilitates the productive population and society as a whole.

- **Gender:** Women have a substantive productive role in the rural sector, including participation in livestock maintenance and management, crop production, and the marketing of rural produce. Integration of gender perspectives in the design and implementation of economic and social policies, programmes and projects is considered central to the national food security strategy.

- **Achieving Dietary Diversity Score:** Dietary diversity has long been recognized as a key element of food security. It is usually measured by summing up the number of foods or food groups consumed over a period of time. Consumption of a more diversified diet is an indicator that the household is food secure, while a less diversified diet is an indicator of food insecurity. Hence, our strategies should focus to apply variety or ensure the inclusion of all five food groups.

Check Your Progress

1. What is the magnitude of malnutrition in India?
2. How does environmental rehabilitation and sustainability promote food security?

6.2.2 National Nutrition Policy Instruments

Nutrition is a multi-sectoral issue and needs to be tackled at various levels through direct and indirect intervention strategies.

A. Direct Intervention – Short Term:

The short term measures, directly reach the community and the results or outcomes of nutrition intervention, especially for the vulnerable groups is possible in a significant period.

- The Universal Immunization Programme, Oral Rehydration Therapy and the Integrated Child Development Services (ICDS) have had a considerable impact on micronutrient deficiency prevention, child survival and mortality reduction.
- With the objective of reducing the incidence of severe and moderate malnutrition effort needs to be made to trigger

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appropriate behavioral changes among the mothers. Improving growth monitoring between the age group 0 to 3 years in particular, with closer involvement of the mothers, is a key intervention.

- **Reaching the adolescent girls:**The government's recent initiative of including the adolescent girls within the ambit of ICDS should be intensified so that they are made ready for a safe motherhood, their nutritional status (including iron supplementation in the body) is improved and should be upgraded with proper nutrition and health education.
- **Ensuring better coverage of expectant women:**In order to reduce the incidence of low birth weight supplementary nutrition should be provided right from 1st trimester and should continue during the major period of lactation, at least for the first one year after pregnancy.
- **Fortification of essential foods:**Essential food items shall be fortified with appropriate nutrients in adequate amounts, for example, salt with iodine and/or iron.
- **Popularization of low cost nutritious food:**
Efforts to produce and popularize low cost nutritious foods from indigenous and locally available raw material shall be intensified. It is necessary to involve women particularly in this activity.
- **Control of micro-nutrient deficiencies amongst vulnerable groups:**Deficiencies of Vitamin A, iron and folic acid and iodine among children, pregnant women and nursing mothers shall be controlled through intensified programmes. Iron supplementation to adolescent girls shall be introduced. These programmes shall be expanded to cover all eligible members of the community.

B. Indirect Policy Instruments- Long Term:

Long term institutional and structural changes to improve nutritional status shall include the following:

- **Food Security:**In order to ensure aggregate food security, a per capita availability of 215kg/person/year of food grain seeds should be attained.
- **Improvement of dietary pattern:**Improving the dietary pattern by promoting the production and increasing the per capita availability of nutritionally rich foods. The production of pulses, oilseeds and other food crops, such as vegetables, fruits, milk, meat, fish and poultry, shall be augmented. Preference shall be given to growing foods, such as millets, legumes, vegetables and fruits (carrots, Green leafy vegetables, guava, papaya and amla). The use of latest and improved techniques shall be increasingly applied, high yielding varieties of food crops developed and extensively cultivated through subsidiary schemes, adequate extension

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services should be made available to farmers, wastage of food in transit and storage must be reduced to the minimum by providing appropriate facilities, available food conserved and effectively utilized and adequate buffer stocks need to be built up.

- **Policies for effective income generation** so as to improve the entitlement package of the rural and urban poor include:

(a) Improving the purchasing power: Poverty alleviation programmes, like the Integrated Rural Development Programme (IRDP) and employment generation schemes like Jawahar Rozgar Yojana and DWCRA are to be re-oriented and restricted to make a forceful dent on the purchasing power of the lowest economic segments of the population. In all poverty alleviation programmes

(b) Public Distribution System: Ensuring an equitable food distribution, through the expansion of the public distribution system. The public distribution system shall ensure availability of essential food articles, such as coarse grains, pulses and jaggery, besides rice, wheat, sugar and oil, conveniently and at reasonable price to the public, particularly to those living below the poverty line, not only in selective areas but throughout the country. Consumer cooperatives and fair price shops shall be opened in adequate number in all areas to ensure availability.

- **Health and Family Welfare:** The Health and family Welfare Programmes are an inseparable part of the strategy. Improved pre-natal and post-natal care, immunization procedures etc. to ensure safe motherhood shall be made accessible to all women.

- **Basic Health and Nutrition Knowledge:** Basic health and nutrition knowledge, with special focus on wholesome infant feeding practices, shall be imparted to the people extensively and effectively.

- **Prevention of Food Adulteration:** Prevention of food adulteration must be strengthened by gearing up the enforcement machinery.

- **Nutrition surveillance:** Nutritional surveillance is another weak area requiring immediate attention. The NNMB/NIN of ICMR needs to be strengthened so that periodical monitoring of the nutritional status of children, adolescent girls and pregnant and lactating mothers below the poverty line takes place through representative samples and results are transmitted to all agencies concerned. Special efforts should be made to improve the effectiveness of programmes related to women.

- **Monitoring Nutritional Programmes:** Monitoring nutritional programmes and nutrition education should be continued to accurately identify those who are suffering from various degrees of malnutrition and in certain cases to measure the outcome of the programmes.

- **Equal Remuneration:** Equal remuneration strategy for both men and women should be reinforced.

- **Communication:** Communication through established media is one of the most important strategies to be adopted for the effective implementation of nutrition policy.

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- **Minimum Wage Administration:** Minimum wage administration ensuring timely revision and linking of wages with price rise is a must.
- **Community Participation:** The active involvement of the community is essential not only in terms of being aware of the services available to the community but also for deriving the maximum benefit from such services by giving timely feedback necessary at all levels.

Community participation will include,

- a) Creating awareness among the community regarding the National Nutritional Policy and its major concerns.
 - b) Involving the community through their Panchayats or beneficiary committees in the management of Nutrition Programmes and interventions related to nutrition, such as Employment Generation, Land Reforms, Health, and Education.
 - c) Promoting schemes relating to kitchen gardens, food preservation, preparation of weaning foods and other food processing units, both at the home level as well as the community levels.
 - d) Generating effective demand at the level of the community for all services relating to nutrition.
- **Education and Literacy:** Education and Literacy particularly that of women is a key determinant for nutritional status. For instance, Kerala state which has the highest literacy level, also has the best nutrition status despite the fact that calorie intake in Kerala is not the highest among all states in country.
 - **Improvement of the status of women:** The most effective way to implement nutrition with mainstream activities in Agriculture, Health, Education and Rural Development is to focus on improving the status of women, particularly the economic status. After all women are the ultimate providers of nutrition to households both through acquisition of food as well as preparation of food for consumption.

6.3 INTEGRATED APPROACH TO SOLVE PROBLEMS OF MALNUTRITION

The International Conference of Nutrition (ICN) was first held in Rome 1992, by the cooperative sponsor of Food and Agricultural Organization and World Health Organization to eradicate hunger and reduce all forms of malnutrition. After 20 years, they planned to review the progress, researched the challenges to attain the highest level of nutrition and the strategies to achieve the goal. So, in 2014, the second meeting of International Conference of Nutrition (ICN2) was held. One of the key objectives of ICN2 was to facilitate a multisectoral and multi-stake holder approach to nutrition, bringing together leaders from health, agriculture,

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education, water, sanitation and hygiene, and other related sectors as well as civil society organizations, parliamentarians, and private sector. This diverse representation allowed for more inclusive policy discussions on nutrition. Hence, it is well understood that, to attain optimal nutrition is not possible by a single measure or approach. It involves multiple related disciplines like agriculture to ensure food security, technology approaches to enhance food production and availability, education to understand the concepts of nutrition, economy to purchase nutritious foods and environmental hygiene and sanitation to prevent infections and maintain health.

On the way to conquer the status of a healthy nation it is worthwhile to know about the intergenerational cycle of malnutrition, and how and why to break it, and as a result it answers the need to solve the prevailing nutritional problems.

6.3.1 Intergenerational Cycle of Malnutrition

Now, having a better understanding on ensuing food and nutrition security, it is very much important to understand the influence of intergenerational cycle on the nutritional status of the community. We had been all the while stressing the importance of nutritional care to be given to the pregnant women, but the bearing of it on the entire generation, has not been discussed. This chain lays the foundation for a healthy community and claims to be an important intervention strategy to break the cycle of malnutrition.

Further, a life course standpoint suggests that nutritional changes are most likely to be continued when they occur during times of developmental transition or milestones such as pregnancy or adolescence. Adolescence is an exclusive period, as the growth spurt is high and also in which malnutrition in future generations may be addressed because it is the first life stage at which pregnancy becomes feasible. A need exists to begin investigating not just how nutrition changes are sustained throughout the lifespan, but how nutritional intervention in one generation impacts the next. This intergenerational approach should be undertaken with cross-discipline collaboration to have the best chance at impacting underlying determinants of malnutrition like poverty and women's education. Hence, an intergenerational cycle is nothing but passing on of the nutritional stature from one generation to another.

When a girl child is not provided enough nourishment, at any stage of life cycle, an inter-generational cycle of malnutrition may set in. The individual level and intergenerational cycles of under-nutrition and ill health together pose serious consequences.

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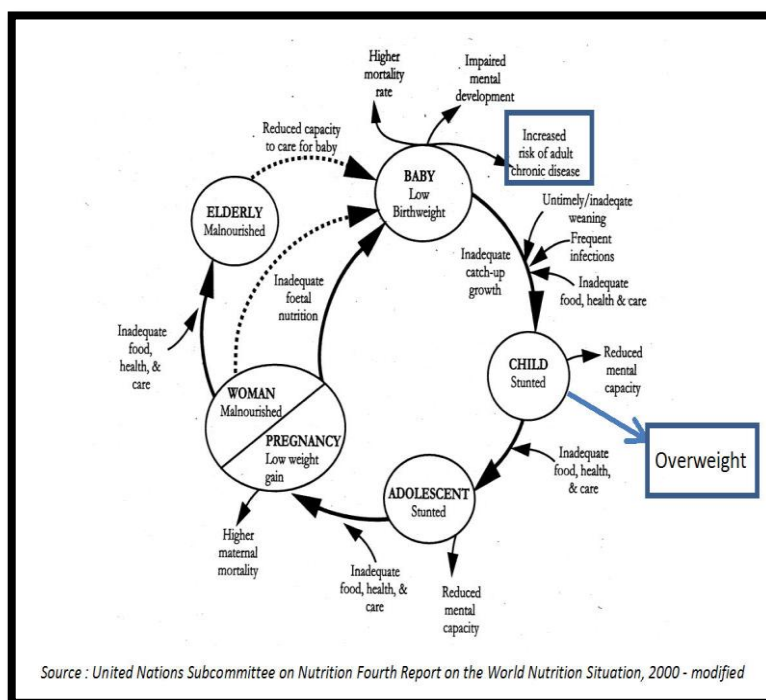


Figure 6.1 Intergenerational Cycle of Malnutrition

A low-birth-weight baby-girl born for a malnourished mother becomes a stunted or malnourished girl child, a stunted or malnourished adolescent, a malnourished woman; and in turn, gives birth to a second-generation low-birth-weight baby. This sequence depicts how poor in-utero nutrition from an under-nourished mother extends through the life cycle affecting nutritional status generation-by-generation. Teenage pregnancies where the adolescent girls have to bear the dual-burden of their own growth and that of the developing foetus leading to still poorer pregnancy outcome that heighten the severity of cycle. Also, closely spaced high parity pregnancies often intensify nutritional deficits which get passed on to their offspring too. Micro-nutrient (iron, zinc, folate, iodine & vitamin A) deficiencies in young girls can aggravate the intergenerational malnutrition cycle. All these magnitudes put together, an intergenerational malnutrition cycle, leads to impaired workforce with reduced work capacity which will mask the nation's development.

6.3.2 Measures to Break the Intergenerational Cycle of Malnutrition

In the light of these adversaries, as a measure to break the intergenerational cycle of malnutrition, nutrition has become an integral component of all the maternal and child health programmes initiated by Government such as:

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Integrated Child Development Services (ICDS), launched on 2nd Oct 1975 has been universalized in the country. The target group comprises children (<6 years), adolescent girls, women in reproductive ages (15-44 years) and pregnant and nursing mothers as well as for improving their nutritional status by providing a package of services right at the grass-roots level. A more detailed discussion on ICDS will be done in next unit.

Reproductive, Maternal, Newborn, Child and Adolescent Health Programme (RMCH+A), launched in 2013) addresses the major causes of mortality among women, children and adolescents along with the reasons for delayed access and utilization of health care services. This strategic approach highlights the importance of 'continuum of care' during various stages of life is imparted through governmental hospitals.

Janani Shishu Suraksha Karyakaram (JSSK), launched on 1st June, 2011 aims to provide better women and child health services such as cost-free delivery care facilities for pregnant and sick new-borns (≤ 30 days post-partum) through government health institutions in rural and urban areas.

Pradhan Mantri Matritva Vandana Yojana (PMMVY) is a maternity benefit program implemented by Ministry of Women & Child Development, Government of India. It is a conditional cash transfer scheme for pregnant and nursing mothers (aged >19 years) for first two live births to partially compensate the childbirth and childcare linked wage-loss. In addition, it provides adequate facilities for safe delivery, breastfeeding and infant feeding.

Pradhan Mantri SurakshitMatritva Abhiyan (PMSMA) aims to reduce maternal and infant mortality rates in the country through safe pregnancies and safe deliveries. It provides quality comprehensive antenatal care to pregnant women on a designated day, usually 9th of every month.

The Mother and Child Tracking System, monitors the health care system to ensure all mothers and their children have an easy access to various health-care services during pregnancy/child-birth and complete maternal & child immunization.

MAA (Mothers' Absolute Affection), an intensified flagship programme of the MoHFW was launched in 2016, aims to enhance optimal breastfeeding practices in the country through a set of comprehensive activities for protecting, promoting and supporting breastfeeding, both at and the facility level. The programme emphasizes on generating community awareness, strengthening inter- accessory support for breastfeeding at delivery points and public health facilities along with the need for adequate family support to the nursing mother.

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India Newborn Action Plan (INAP), launched in September 2014, aims to end preventable new-born deaths and stillbirths so as to achieve single digit neonatal mortality and stillbirth rates by 2030.

Adolescent Reproductive and Sexual Health (ARSH) programme comprises the package of preventive, promotive, curative and counselling services for addressing their reproductive and sexual issues.

Other programmes or schemes targeting adolescent girls include Kishori Shakti Yojana, Balika Samridhi Yojana, and Scheme for Adolescent Girls (SABLA), Weekly Iron and Folic Acid Supplementation (WIFS) programme, Menstrual Hygiene Scheme and many more. These programmes aim at empowering the adolescents with improved nutrition and health related awareness as well as better nutritional status so that they enter family life and motherhood with better nourishment.

Under UIP, Mission Indradhanush is cost-free expanded immunization coverage for children against 7 vaccine preventable diseases (Diphtheria, Pertussis, Tetanus, Childhood-Tuberculosis, Polio, Hepatitis B and Measles) by 2020. Further, Swachh

Bharat, BetiBachaoBetiPadaoAbhiyan, and adolescent friendly clinics also address critical nutrition-sensitive issues of adolescents.

Correspondingly, Nutrition education, which involves effective interpersonal or small groups counselling should be carried out to highlight the advantages of balanced nutrition, breastfeeding vs. the dangers of artificial feeding, child rearing and feeding practices, weaning foods and thus prepare the expectant mothers for successful parenting. Role of nutrition education as a strategy to overcome malnutrition is discussed in detail in UNIT-11. It is thus, possible that through concrete integrated efforts, the intergenerational cycle of malnutrition can be turned virtuous and improvements in maternal nutritional status and pregnancy outcome can be achieved. Diet substantiating the quantity and quality demands, micronutrient supplementation and improved health services can be the catalytic strategies for bringing about the desired change. As per the continuum of care approach, focusing on girl child to women along the lifecycle is imperative for achieving the Sustainable Development Goals (SDGs) and overcoming poverty, malnutrition and ill-health.

Check Your Progress

3. Who are the beneficiaries of RMCH+A?

4. What is an integrated approach?

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6.3.3 Need for an Integrated Approach

We should now recollect our Unit-1, where we have discussed the causes of malnutrition. As we are aware that the causes of malnutrition are manifold (demographic, geographic, economy, food insecurity, ignorance), a single approach cannot help to overcome malnutrition. Hence, an integrated approach should be employed at different levels to enhance the nutritional status. The multiple interventions should target multiple economic sectors (such as agriculture, health, water, energy, infrastructure, and finance) and at the same time the policymakers, funders, and development organizations should integrate to frame relevant policy domains (such as those related to social, economic and financial affairs, gender, education, and human security), while additionally ensuring coherence at different levels (local, regional, national and international) and connecting relevant stakeholders (like decision-makers, scientists, practitioners, businesses and citizens). These implementers of the programme should integrate and collectively look into the major problems and find solutions to the serious problems of mankind. A comprehensive and dynamic system capable of integrated action would increase the pace of progress towards a more equitable order. This lineup effort as a cycle would interrupt the vicious cycle of malnutrition in which we are caught and will impact the nutritional status, in a righteous way. Even the programmes run by the Government to overcome malnutrition, if keenly observed integrates health, education, monetary benefits, sanitation and women empowerment. Thus, malnutrition cannot be alleviated by a single strategy in a single step as the causative factors are multiple. Hence, it is imperious that all disciplines and fields combine together and pave the way to overcome malnutrition.

The multiple arenas that are involved in combating malnutrition will be discussed in detail in unit-7.

6.4 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

1. Malnutrition manifest itself in terms of illness and death in all age groups. Children, pregnant women, nursing mothers and elderly are vulnerable to the effects of malnutrition. Malnutrition contributes to more than half of child death worldwide. Further, the risk of death rises with increase in the grade of malnourishment among children from mild to moderate to severely malnourished. Also, FAO in the “The State of Food Security and Nutrition in the World” 2017 edition points that 190.7 million people are undernourished, while 21% children under 5 years are underweight, 38.4% children under 5 years are stunted in India. Even more heart throbbing fact is that India bears the largest undernourished population in the world. These figures illustrate the magnitude of malnutrition in India to us very well. Hence, it’s high time to devise effective strategies to overcome the nutritional problems.

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2.Environmental rehabilitation and sustainability is critical to the pursuit of food security and economic development generally. Development depends on the appropriate and sustainable use of the environment and the management of natural resources. Measures to reverse the level of land degradation and create a source of income generation for food-insecure households through a focus on biological measures, such as re-forestation and land preservation. Focus on agriculture backward rural areas, tribal areas and areas affected by natural calamities should be continuously monitored for sustenance of agriculture. Poverty and Food insecurity is greater in dry land areas. So employment and nutrition oriented programmes must be highly focused in these areas.

3. Reproductive, Maternal, Newborn, Child and Adolescent Health Programme (RMCH+A, launched in 2013) addresses the major causes of mortality among women, children and adolescents along with the reasons for delayed access and utilization of health care services. This strategic approach highlights the importance of ‘continuum of care’ during various stages of life is imparted through governmental hospitals.

4.To attain optimal nutrition is not possible by a single measure or approach. It involves multiple related disciplines like agriculture to ensure food security, technology approaches to enhance food production and availability, education to understand the concepts of nutrition, economy to purchase nutritious foods and environmental hygiene and sanitation to prevent infections and maintain health. On the way to conquer the status of a healthy nation it is worthwhile to know about the intergenerational cycle of malnutrition, and how and why to break it, and as a result it answers the need to solve the prevailing nutritional problems.

6.5 SUMMARY

To summarize, as health educators, we bear the responsibility of ensuring that the following integral strategies,integratedare available in our community settings to improve the nutritional status of the community we live in.

- **Basic education:** Providing equal chances of education for both boys and girls is important to enable them to become better parents themselves and this is a very important and crucial strategy for improving child nutrition and care. Therefore advocacy should be done to promote education at all levels.
- **Healthy environment:** Availability and easy access to safe and adequate water for drinking, cooking and cleaning are important aspects of each person's development and the maintenance of their health.
- **Maternal and childcare:** Prevention of premature births, proper antenatal care and promotion of good feeding practices are important

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interventions that may help to decrease malnutrition within the community.

- **Healthy social and family life:** Strong family planning services may help families to limit the number of children they have, social integration and communal care may support orphans and children with special needs.
- **Proper agriculture:** Diversification through planting the right number of different kinds of seeds should be promoted, and food distribution at household level should be equitable, giving children and pregnant mothers priority.
- **Public health measures:** These include prevention and treatment of maternal infections during pregnancy and delivery. Immunizations against preventable diseases as well as an emphasis on growth promotion and monitoring activities are also important public health strategies to prevent malnutrition in the community.

6.6 KEY WORDS

- **Dietary Diversity:** Sum of the number of foods or food groups consumed over a period of time.
- **Intergenerational Cycle:** Passing on of the nutritional stature from one generation to another.
- **Integrated Approach:** Bringing together different disciplines involved in the cycle of malnutrition to fight against malnutrition.

6.7 SELF ASSESSMENT QUESTIONS

Short Answer Questions

1. A single measure will not prevent malnutrition - Justify.
2. What are the different arenas to be strengthened to overcome malnutrition?
3. What is intergenerational cycle? How does it affect the nutritional status of generations?
4. Discuss the food security strategies to combat food insecurity.

Long Answer Questions

1. Elaborate the measures to break the intergenerational cycle of malnutrition.
2. Explain the National Nutrition Policy Instruments as an integrated approach to improve nutritional status.
3. Elaborate the measures to be adopted to sustain food and nutrition security.

6.8 FURTHER READINGS

- Suryatapas, 2018, Textbook of Community Nutrition, 3rd Edition, Academic Publishers, West Bengal.
- Prabha Bisht, 2017, Community Nutrition in India, Star Publications, Agra.

- Srilakshmi.B, 2016, Nutrition Science, New Age International Publishers, New Delhi.
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- FAO Reports.

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UNIT – 7 NUTRITION INTERVENTION PROGRAMMES

Structure

- 7.0 Introduction
- 7.1 Objectives
- 7.2 Nutrition Intervention Programmes
 - 7.3 Integrated Approaches to Combat Malnutrition
 - 7.3.1 Agriculture Planning
 - 7.3.2 Role of Food Technology
 - 7.3.3 Environmental Sanitation and Health
- 7.4 Answers to check your Progress Questions
- 7.5 Summary
- 7.6 Key Words
- 7.7 Self-Assessment Questions and Answers
- 7.8 Further Readings

7.0 INTRODUCTION

In the previous units, we have learnt about the prevalence of malnutrition, micronutrient deficiencies, morbidity, and mortality arising of either under nutrition or over nutrition. It is not sufficient if we are aware about the detrimental health covers. We should also take steps to understand the different nutrition policy or intervention programmes prevailing, how they are helping to improve the community's nutrition status etc. In unit –VI, we have outlined the importance of integrated approach to overcome malnutrition. In this context, this unit will teach about what the nutrition intervention programme is all about and the role of various multi sectoral approaches like agriculture, food technology and environment sanitation and health in overcoming malnutrition.

7.1 OBJECTIVES

After studying this unit you will be able to

- Define and describe the need for nutrition intervention programmes.
- Role of nutrition intervention programme in improving community health.
- Describe the influence of agriculture, food technology and environmental sanitation and health on nutritional status of the community.

7.2 NUTRITION INTERVENTION PROGRAMMES

Nutrition Intervention is defined as purposefully planned actions intended to positively change a nutrition- related behavior, environmental condition,

or aspect of health status for an individual, target group, or the community at large.

The purpose of nutrition intervention programmes are to improve the nutritional status of the community by:

- Stimulating and sustaining the production, availability and consumption of more nutritious foods.
- Ensure awareness of public health programmes.
- Resolve or improve the nutrition diagnosis or nutrition problem by provision of supplementation and / or education.
- Promote proper food habits and healthy lifestyles.
- Reduce the prevalence of protein-energy malnutrition.
- Reduce the prevalence of micronutrient deficiency, particularly vitamin A, folic acid, calcium, iron, and iodine, among vulnerable groups and
- Reduce over-consumption of fat, empty calories, sodium, and alcohol.

Nutrition intervention can be executed through any of these four domains:

Food and/or Nutrient Delivery: Individualized approach for Food or nutrient provision.

Nutrition Education: A formal process to instruct or train a person in a skill or to impart knowledge to help persons voluntarily manage or modify food, nutrition and physical activity choices and behavior to maintain or improve health.

Nutrition Counselling: A supportive process, characterized by a collaborative counsellor-patient relationship, to establish food, nutrition and physical activity priorities, goals, and individualized action plans that acknowledge and foster responsibility for self-care to treat an existing condition and promote health.

Coordination of Nutrition Care: Consultation with, referral to, or coordination of nutrition care with other health care providers, institutions, or agencies that can assist in treating or managing nutrition-related problems.

The nodal responsibility of providing optimal health to all, rests with the Ministry of Human Resource Development which encompasses Departments of Women and Child Development, Agriculture, Food, Civil Supplies, Health and Family Welfare, Rural Development, Education, Environment and Finance each of which have an individual crucial role for providing a sustained growth in nutrition and health, through nutrition intervention programmes.

Thus, the Government serves to attain the objectives of nutrition intervention by programmes implemented through five year plans, by

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means of any of the above listed domains. The five year plan recommends specific nutritional goals to be achieved at the end of five years. In previous years, 10th five year plan (2002-2007), 11th five year plan (2007-2012) and 12th five year plan (2012-2017) were oriented towards achieving good health for all people, especially the poor and underprivileged by advocating improvements in individual health care, public health, sanitation, clean drinking water, access to food and knowledge of hygiene and feeding practices.

The health outcome goals would be achieved by nutrition action at different levels which include:

- **Strengthening nutrition in medical, paramedical and agricultural education:** Eradication of micronutrient deficiencies, examining the social causes of malnutrition, Nutritional feeding of infants and young children as a part of medical and nursing curriculum, nutrition advocacy and education for agricultural students and scientist.
- **Training Programme for Health Personnel:** Hospital staff, health workers, health counsellors should be trained to address the problems of malnutrition, low birth weight, breast feeding, supplementary feeding, supplementation of vitamin A, iron and folate.
- **Establishing Nutrition Information System in the Country:** To assess the outcome of nutritional programmes a proper standardised management information system (MIS) is set. The efficacy of various services offered by National Rural Health Mission, ICDS are monitored, mapped and surveyed through MIS. **National Nutrition Monitoring Bureau (NNMB)** undertakes diet and nutrition surveys to project the state wise nutritional status. It projects status of diet related chronic diseases in the country to enable region specific and nutrient specific preventive strategies.
- **National Family Health Survey (NFHS)** provides nationwide data on undernutrition among children under 5 years and anaemia among women and children.
- **District Level Health Survey (DLHS)** covers all districts in phased manner and projects district level nutrition and health scenario.
- **Strengthening Intersectoral Co-ordination Mechanism:** A high level inter agency co-ordination mechanism is necessary to enable directions to the concerned sectors. A regular co-ordination between Health and Family Welfare and Women and Child Development departments is essential as these are the key sectors which implement largest health and nutrition programs in the country.
- **Enhancing Investment in Nutrition and Health:** Investment in health programmes is not an expense rather, it fetches higher economic growth and over all development. Allocating sufficient funds will enhance the efficiency of the nutrition programmes and outcome.

- **Building Institutional Capacity for Nutrition Action:** The national institutes in the field of nutrition have not expanded much and their structures have not widened. National Institute of Nutrition, NNMB, Food and Nutrition departments of home sciences colleges, Food and Nutrition Board although have taken great strides, the population growth and severity of malnutrition prevailing in the country demands a lot more from them.

The efforts and outcomes of all these components should be pooled together to succeed in the nutrition intervention programmes.

Through the past five year plans, even though, the outcome was productive and has achieved positive improvements in nutritional status, it is not sufficient enough to achieve disease free society.

After 2017, the five year plans have been replaced by NITI (National Institution for Transforming India) Aayog, which was established in 2015, by Government of India, in order to achieve Sustainable Development Goals (SDG) with the involvement of State Governments. Its initiatives include agricultural reforms, Indices measuring states performance in health, skill development, education and water management and overcoming poverty. All these missions if integrated and put in action will overcome malnutrition.

Check Your Progress

1. **How can health outcomes be achieved?**
2. **Explain the ways in which government administers nutrition intervention.**

With this introduction to nutrition intervention programmes in this unit, we shall discuss about the different programmes in action, the objectives in the next unit.

7.3 INTEGRATED APPROACHES TO COMBAT MALNUTRITION

Achieving the goal of nutrition intervention will require closer collaboration across the sectors of agriculture, nutrition, and health, which have long operated in separate spheres with little recognition of how their actions affect each other. It is time for agriculture, nutrition, and health to join forces in pursuit of the common goal of improving human well-being.

A brief introduction for the need of these integrated approaches to overcome malnutrition has been given in unit-VI. With that in mind, let us move on to the detailed notes.

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7.3.1 Agriculture Planning

You may be aware that the fundamental purpose of agriculture is to produce food and raw materials, but it does not end there, another important motive of agriculture is to nurture healthy, well-nourished people. Though, Nutrition is an important factor that influence health and well-being of people, agriculture lays the foundation to achieve optimum nutrition. Consumption of diets adequate both in quantity and quality is a prerequisite for the maintenance of good nutritional status, but this rests on agriculture. Agricultural production that determines food availability is, therefore, an important determination food consumption, though not a critical one if food imports can be assured. The sufficiency in food production is of particular importance for developing countries only because they tend to have high rates of population growth, but also because of countries have malnutrition as a public health problem. The quantitative aspects of production are undoubtedly of primary concern, but it cannot be forgotten that qualitative aspects are extremely important, if optimal nutrition is to be provided. The interphase between agriculture and nutrition, therefore, acquires considerable practical importance. We will study issue related to food grains and horticultural products (fruits and vegetables) their storage and distribution and see how they affect the consumption pattern of population

Food production in India has increased substantially over the years. One of the most achievements in the last 50 years has been the Green Revolution and self-sufficiency in food production. The green revolution has been most striking in the areas of water production where yields have increased consistently over the years to reach an average of 27 kg/hectare in 1999-2000 from a figure of 827 kg/hectare in 1965-66. Country with an almost two fold increase in the area under cultivation over the same time period, the total production of wheat has increased fivefold. The rice yields have been comparable though the area under rice cultivation has also increased, but much slower rate. In the case of coarse cereals, an almost stagnant area under cultivation leading to a production figure of around 20-30 million tones over the three decades offsets the small increase in productivity.

The nutritional status of a population is largely determined by the quality and quantity of food consumed by the individual members. The per capita availability of food is an important, though not the sole, determinant of the pattern of consumption. This is an addiction of food grain production and growth of the population. The Indian population has been growing at the rate of a little over 2% per annum since 1971. The food grain production increased at an annual rate of 3.2% during 1950-65, with higher rates for rice and wheat and lower ones for coarse cereals and pulses. The post Growth Revolution era records the maximum growth in wheat (2.3% per annum) but low output of almost all other crops. Thus, in spite of an

overall watching pace of growth between population and food production, gains in per capita availability of foods have not been impressive.

At the national level, food production appears to be sufficient to meet the country's needs. In actual practice, however, food consumption does not follow normal distribution but is skewed. In the last two decades, there has been a progressive decline in pulse consumption, especially among the poor segments of the population. A large number of families consume diets that do not provide enough energy, and of these, a proportion do not get enough proteins – a finding that explains widespread PEM among young children. The primary reason for such inequitable distribution is lack of purchasing power. The impressive stocks of food grains, held in recent years, is, in fact, a reflection of this low buying power and consumption. Stocks would have been far less impressive if people could have afforded to buy what they needed. Wages and incomes have gone up over the years but they do not seem to have kept pace with rising costs of even essential food commodities.

Data collected by the National Nutrition Monitoring Bureau show that food consumption has not changed significantly over the last few years. To illustrate, pre-school children constitute one of the most nutritionally vulnerable segment of the population and their nutritional status is considered to be a sensitive indicator of community health and nutrition. There, has not been a substantial improvement in their nutrient intake, particular the energy intake over the last two decades.

Due to increased agricultural production in the country, we were able to prevent the serious widespread famines that used to occur in earlier years. Both are no mean achievements. The increased production seems to have made a little impact on the widespread chronic malnutrition in the country, with all its health and development implications.

In spite of huge buffer stocks, 8% of Indians do not eat two meals a day and they are pockets where severe undernutrition takes their toll even today. Every third child born is underweight. About 50% of the preschoolers suffer from under nutrition. Micronutrient deficiencies are widespread. Undernutrition associated with HIV/AIDS will soon emerge as a public health problem. Alterations in lifestyle and dietary intake have lead to increasing prevalence of obesity and associated non-communicable disease. In the new century, the country will have to gear itself to prevent and combat the due burden of under and over nutrition and associated health problems.

We say, increased agricultural production is a key factor in ensuring adequate food supply. Without stopping with the production, the agricultural policy of a country will have to take care of the relevant

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aspects of its nutrition policy too, if the food needs of the population have to be met. Imbalances in production of different commodities have to be corrected and more importantly, food has to be made available at a cost that the great majority can afford. Until such time adequacy of agricultural production will be more apparent than real. It must not be forgotten that factors outside agriculture also have a role in influencing nutrition.

Thus, from our discussion above, it is evident that although food grain production has considerably increased at national level over the last 50 years, we have large number of people in our country who do not consume diets with adequate calorie and protein intakes. Next, let us now look at issues related to fruits and vegetables, and how they influence consumption levels of population, as most of the micronutrient deficiencies are associated with fruits and vegetables.

We know that vegetables and fruits constitute an integral part of the predominantly vegetarian Indian dietary pattern. They provide the much-needed variety to the otherwise prosaic, ubiquitous cereal pulse meal pattern practiced in most Indian homes. An area of 12 million hectares comprising 7% of the total cropped area of the country is utilized for growing fruits and vegetables. Out of this, 12% is under vegetable cultivation. India became the largest producer of fruits in 1993 (31.9 million tonnes) after overtaking of Brazil (31.2 million tonnes). It ranks second to China in vegetable production with a figure of 90.8 million tonnes during 1999-2000.

However, per capita consumption of these in the country is very low. Consumption of adequate quantities of vegetables, especially, green leafy vegetables is essential for meeting the dietary requirements of vital micronutrients. Besides, vegetables also provide several phytochemicals and fibre. At present, there is an insufficient focus on the cultivation and marketing of low cost locally acceptable green leafy vegetables, yellow vegetables and fruits. As a result, these vegetables are not available at affordable cost throughout the year. Health and nutrition education emphasizing the importance of consuming these inexpensive but rich sources of micronutrients will not result in any change in food habits unless the horticultural resources in the country are harnessed and managed effectively to meet the growing needs of the people at an affordable cost.

As a means to overcome this burden of expense on fruits and vegetables, Homestead food production (HFP) can be encouraged as an agricultural development strategy, particularly for households with limited land. Linkages among gender, agriculture, health, and nutrition are easily traced: the strategy aims to increase dietary diversity using household labor intensively on small gardens within the homestead, allowing women to grow a variety of fruits and vegetables and tend small livestock while fulfilling their domestic and child care responsibilities.

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Agriculture is not an independent factor. Agriculture, nutrition, and health all have important links to the natural environment. Unsustainable management of land, water, and other natural resources can lead to soil erosion, siltation in watersheds, seasonal water scarcities, and water-borne and insect vector-transmitted diseases, with negative effects on agricultural yields and incomes as well as on nutrition and health. In contrast, sustainable management of land and water and preservation of biodiversity can help improve health and nutrition not only directly but also indirectly by maintaining agricultural yields and incomes.

Also, we need to continue to emphasize that agriculture has a unique and critical role in improving nutritional status. The three linking factors that deserve particular attention are: **Agriculture has the most direct influence and contact with the majority of households where undernourished individuals reside worldwide:** Beneficiaries of typical agricultural projects overlap with those most affected by undernutrition namely, the rural poor. 78% of the world's poor are rural, and most of them are smallholder farmers. Any development activity reaching this population has enormous potential to influence factors that constrain human capital and well-being, of which nutrition is an essential part. For example, agriculture extension workers have direct and ongoing contact with smallholder farmers, and therefore have a unique opportunity to strengthen messages regarding not just production, but also consumption of nutritious foods, including bio-fortified crops, especially by vulnerable groups, including pregnant women and young children.

Agricultural-led growth is more pro-poor than non-agricultural-led growth, thereby increasing agriculture's potential to improve nutrition: Agricultural growth is at least twice as effective in reducing poverty as GDP growth originating outside agriculture and is therefore pro-poor. Agriculture-led growth has led to faster declines in undernutrition than non-agricultural growth in many countries, although there are exceptions to this, as in the case of India.

Agriculture is the sector best placed to affect food production and consumption of nutritious foods needed for healthy and active lives: Physical and economic access to adequate and affordable nutritious food is primarily a function of the agriculture sector, through support to increased production, improved post-harvest storage and processing and reduced transport costs which can lower food prices for poor consumers. Agriculture does not directly influence consumer demand but can help make nutritious food available to consumers at affordable prices.

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Thus, agriculture based development programs that aim to improve nutrition have tended to focus on agricultural production and consumption by producer households. Yet the links among what is produced on the farm, the consumer, and the income received by the producer do not stop at the farm gate. Far from it: food is stored, distributed, processed, retailed, prepared, and consumed in a range of ways that affect the availability, affordability, acceptability, and nutritional quality of foods for the consumer. Therefore, if the agriculture sector is to play a more important role in improving nutrition, there needs to be a greater focus on what happens between production and consumption.

The food products produced with so much of efforts should be distributed evenly to the needy. The sluggish movement of food grains, fruits or vegetables from the area of produce to the consumer will lead to deterioration on the way causing a huge economic loss, nutritional deficit as well. However, access to proper storage means will minimise the loss.

Given the weak food control systems, poor infrastructure, lack of resources, and improper food handling common in many developing countries, food- and water-borne diseases impose a high burden on poor people, yet they are often overlooked, unreported, or ignored. Improvements should be made to food safety along the entire food chain, from production to storage, transportation, and processing. Also needed are improvements in surveillance systems and in public awareness of basic hygiene and food safety measures.

7.3.2 Role of Food Technology

The solution to food and nutrition problems requires a sound understanding of the interface aspects, in which agricultural scientists, food technologists, nutritionists and others concerned would constantly interact with each other to ensure a multidisciplinary system and work as an interdisciplinary team in a concerted manner. Only through such programmes of action can the total agro-economic system contribute to bringing about the socio-economic transformation of the developing countries, and provide the stimulus that can overcome poverty through acceleration of the development process. The problems involved in bridging the wide gap between the national nutritional needs of the developing countries and available food supplies can be approached by the following lines of action, which can be taken up simultaneously: (a) increasing food production through better food technology (b) ensuring effective conservation and utilization of food through the application of modern technology.

The last 30 years have witnessed spectacular increases in food-grain production in India. A sizeable buffer stock has also been built up to face the likely shortages arising out of uncertain production levels. Breeding of new food-grain varieties has been directed to increasing per hectare yields and resistance against field-borne microorganisms and insect pests.

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Another innovation for leveraging food technology to improve nutrition is biofortification—the breeding of new varieties of food crops with improved nutritional content. When people in malnourished communities receive these varieties to grow and eat, biofortified crops can contribute to the overall reduction of micronutrient deficiencies in a population. Compared with other approaches to micronutrient malnutrition, such as supplementation and fortification, biofortification offers several advantages: it targets poor people and rural areas; it is cost-effective because after the initial investment in research, the crops are available year after year; and it is sustainable because it relies on staple crops that people are already accustomed to eating. Example of vitamin A fortified golden rice had been cited in unit 4.

Advances in food technology and nutrition have, however, given some insight into the desirable features that need to be considered in breeding programmes. The impressive growth in food-grain production during the last 30 years has resulted from increases in the area under cultivation for food-grain crops, improvement in per hectare yield, introduction of high-yielding varieties, particularly of wheat and rice and provision of irrigation and other inputs. Maximum productivity has been sought by judicious water-management practices, appropriate cropping systems (double, triple, and multiple) under dry and irrigated conditions, improved dry land agriculture (mulching, recycling of runoff water to provide supplementary irrigation, and choice of crop compatible with season), intercropping, multilevel cropping and mixed farming practices.

About 70 percent of food grains produced in India are retained for farm-level consumption and the rest moves along a chain of agencies before it reaches the consumption points. Post-harvest conservation by modern procedures is, therefore, a crucial need to prevent the dissipation of national efforts to raise food production levels. The incidence of bunt in wheat, chalky grains in rice, and gibberella infection in maize, and the impairment of processing qualities as a result of pre-harvest infection have engaged the attention of scientists in recent years. The expertise in food conservation built up during the last 30 years has found increasing application, but basic information to evolve varieties with desirable storage, processing, and nutritional or organoleptic qualities is important in meeting future needs. Variable production level in different years emphasizes the need for the varieties that give maximum yields during processing and suffer minimum losses during post-harvest handling and storage.

Post-harvest losses especially in vegetables and fruits are presently in the range of 20-30%. They contribute directly to higher costs and reduce availability of these commodities. Precision farming and processing based on science and technology are both intellectually stimulating and

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economically rewarding as they would enable the micronutrient needs of the population to be met through a sustainable food based approach. This brings us to the next issue of how consumers can feel more secure in terms of food availability, accessibility and consumption.

7.3.3 Environmental Sanitation and Health

The World Health Organization (WHO) estimates that in 2004 unsafe water, lack of hygiene, and insufficient sanitation were responsible for 1.9 million deaths and 64.2 million disability-adjusted life years (2009). Emerging zoonotic diseases are likewise of major concern, particularly in developing countries. Such diseases and their causes are often not recognized because of the lack of diagnostic capacity along the value chain and poor infrastructure. The World Bank (2010) estimates the costs of zoonotic diseases (including human and animal health service costs, compensation for lost animals, and production and revenue losses to the livestock sector) between 2000 and 2010 to be in excess of US\$20 billion (or more than \$200 billion with associated indirect costs).

In urban and semi-urban areas, untreated wastewater used to irrigate food crops may be severely contaminated with chemicals. While export crops are generally carefully regulated for food safety, items for domestic consumption are less well scrutinized, and while exposure to agricultural chemicals is known to lead to varied health effects, including birth defects, blindness, cancer, and even death, their levels are weakly monitored in most developing countries.

Delivery of safe food will ultimately require a combination of pull from markets and push from public health and regulatory bodies. The problems that arise from food and water safety concerns affect different consumers in different ways.

For examples, Diarrheal diseases impact children most severely, killing more than 2 million young children a year in the developing world. Many more are left underweight, stunted mentally and physically, vulnerable to other deadly diseases, and too debilitated to go to school.

Water supply, sanitation and health are closely related. Poor hygiene, inadequate quantities and quality of drinking water, and lack of sanitation facilities cause millions of the world's poorest people to die from preventable diseases each year. Women and children are the main victims.

Ministry of Environment & Forests, Govt. of India stats that, Water, sanitation and health are linked in many ways:

Contaminated water that is consumed may result in water-borne diseases including viral hepatitis, typhoid, cholera, dysentery and other diseases that cause diarrhoea.

- Without adequate quantities of water for personal hygiene, skin and eye infections (trachoma) spread easily.

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- Water-based diseases and water-related vector-borne diseases can result from water supply projects (including dams and irrigation structures) that inadvertently provide habitats for mosquitoes and snails that are intermediate hosts of parasites that cause malaria, schistosomiasis, lymphatic filariasis, onchocerciasis and Japanese encephalitis.
- Drinking water supplies that contain high amounts of certain chemicals (like arsenic and nitrates) can cause serious disease.
- Inadequate water, sanitation and hygiene account for a large part of the burden of illness and death in developing countries.
- Lack of clean water and sanitation is the second most important risk factor in terms of the global burden of disease, after malnutrition.
- Intestinal worms infect about 10% of the population of the developing world, and can lead to malnutrition, anaemia and retarded growth.
- 6 million people are blind from trachoma and the population at risk is about 500 million.
- 300 million people suffer from malaria.
- 200 million people are infected with schistosomiasis, 20 million of whom suffer severe consequences.

Also, a simple fact is that improved sanitation contributes enormously to human health and well-being, especially for girls and women. Basic health education imparted at school level can do wonders at less cost. Improving sanitation by providing access to toilets for all, helps create physical environments that enhance safety, dignity and self-esteem. Safe disposal of human waste is an essential environmental health measure. This intervention can contribute to the reduction of the transmission of health-care associated infections which affect 5% to 30% of people.

Check Your Progress

3. Are we able to prevent malnutrition with increased food production?
4. How does contaminated water cause infection?

7.4 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

1. The health outcome goals would be achieved by nutrition action at different levels which include:

- **Strengthening nutrition in medical, paramedical and agricultural education:** Eradication of micronutrient deficiencies, examining the social causes of malnutrition, Nutritional feeding of infants and young children as a part of medical and nursing

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curriculum, nutrition advocacy and education for agricultural students and scientist.

- **Training Programme for Health Personnel:** Hospital staff, health workers, health counsellors should be trained to address the problems of malnutrition, low birth weight, breast feeding, supplementary feeding, supplementation of vitamin A, iron and folate.
- **Establishing Nutrition Information System in the Country:** To assess the outcome of nutritional programmes a proper standardised management information system (MIS) is set. The efficacy of various services offered by National Rural Health Mission, ICDS are monitored, mapped and surveyed through MIS. **National Nutrition Monitoring Bureau (NNMB)** undertakes diet and nutrition surveys to project the state wise nutritional status. It projects status of diet related chronic diseases in the country to enable region specific and nutrient specific preventive strategies.
- **National Family Health Survey (NFHS)** provides nationwide data on undernutrition among children under 5 years and anaemia among women and children.
- **District Level Health Survey (DLHS)** covers all districts in phased manner and projects district level nutrition and health scenario.
- **Strengthening Intersectoral Co-ordination Mechanism:** A high level inter agency co-ordination mechanism is necessary to enable directions to the concerned sectors. A regular co-ordination between Health and Family Welfare and Women and Child Development departments is essential as these are the key sectors which implement largest health and nutrition programs in the country.
- **Enhancing Investment in Nutrition and Health:** Investment in health programmes is not an expense rather, it fetches higher economic growth and over all development. Allocating sufficient funds will enhance the efficiency of the nutrition programmes and outcome.
- **Building Institutional Capacity for Nutrition Action:** The national institutes in the field of nutrition have not expanded much and their structures have not widened. National Institute of Nutrition, NNMB, Food and Nutrition departments of home sciences colleges, Food and Nutrition Board although have taken great strides, the population growth and severity of malnutrition prevailing in the country demands a lot more from them.

2. Food and/or Nutrient Delivery: Individualized approach for Food or nutrient provision. **Nutrition Education:** A formal process to instruct or train a person in a skill or to impart knowledge to help persons voluntarily manage or modify food, nutrition and physical activity choices and behavior to maintain or improve health. **Nutrition Counselling:** A supportive process, characterized by a collaborative counsellor-patient relationship, to establish food, nutrition and physical activity priorities,

goals, and individualized action plans that acknowledge and foster responsibility for self-care to treat an existing condition and promote health. **Coordination of Nutrition Care:** Consultation with, referral to, or coordination of nutrition care with other health care providers, institutions, or agencies that can assist in treating or managing nutrition-related problems.

The nodal responsibility of providing optimal health to all, rests with the Ministry of Human Resource Development which encompasses Departments of Women and Child Development, Agriculture, Food, Civil Supplies, Health and Family Welfare, Rural Development, Education, Environment and Finance each of which have an individual crucial role for providing a sustained growth in nutrition and health, through nutrition intervention programmes. Thus, the Government serves to attain the objectives of nutrition intervention by programmes implemented through five year plans, by means of any of the above listed domains. The five year plan recommends specific nutritional goals to be achieved at the end of five years. In previous years, 10th five year plan (2002-2007), 11th five year plan (2007-2012) and 12th five year plan (2012-2017) were oriented towards achieving good health for all people, especially the poor and underprivileged by advocating improvements in individual health care, public health, sanitation, clean drinking water, access to food and knowledge of hygiene and feeding practices.

3. The last 30 years have witnessed spectacular increases in food-grain production in India. A sizeable buffer stock has also been built up to face the likely shortages arising out of uncertain production levels. Breeding of new food-grain varieties has been directed to increasing per hectare yields and resistance against field-borne microorganisms and insect pests. But still malnutrition prevails.

5. Contaminated water that is consumed may result in water-borne diseases including viral hepatitis, typhoid, cholera, dysentery and other diseases that cause diarrhoea. Without adequate quantities of water for personal hygiene, skin and eye infections (trachoma) spread easily. Water-based diseases and water-related vector-borne diseases can result from water supply projects (including dams and irrigation structures) that inadvertently provide habitats for mosquitoes and snails that are intermediate hosts of parasites that cause malaria, schistosomiasis, lymphatic filariasis, onchocerciasis and Japanese encephalitis. Drinking water supplies that contain high amounts of certain chemicals (like arsenic and nitrates) can cause serious disease.

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7.5 SUMMARY

Despite great strides in food production, agricultural growth has not had its expected benefits for nutrition in India, which is home to one-third of the world's undernourished children. One part of the solution to this "Indian enigma" likely involves focusing on crops and livestock that have large nutritional impacts on both farmers and consumers. Another part may involve addressing socioeconomic factors that affect the link between agriculture and nutrition, including the distribution of assets, particularly land; the role and social status of women; rural infrastructure; and rural health and sanitation. Yet another part involves addressing other drivers of undernutrition by, for example, improving education and social welfare systems. Thus, complementary programs in nutrition, health, water and sanitation, and behavior change communication need to be implemented and targeted to vulnerable populations, especially women and young children. More broadly, improvements in healthcare access and female education and reductions in fertility rates and poverty will help make nutrition more responsive.

7.6 KEY WORDS

- **Sanitation:** conditions relating to public health, especially the provision of clean drinking water and adequate sewage disposal.
- **Intervention:** action taken to improve a medical disorder.
- **Post-Harvest Technology:** Science and Technique" applied to agricultural produce after harvest for its protection, conservation, processing, packaging, distribution, marketing, and utilization to meet the food and nutritional requirements of the people in relation to their needs.

7.7 SELF-ASSESSMENT QUESTIONS

Short Answer Questions

1. Define nutrition intervention. List the domains involved in it.
2. What are the ways in which agriculture relates to nutrition?
3. How does science and technology help improve food supply?
4. Discuss the importance of sanitation in ensuring health and nutrition.

Long Answer Questions

1. Elaborate on the multi sectoral approaches to solve nutritional problems.
2. Write a detailed note on the purpose, features and execution of nutrition intervention programmes.

7.8 FURTHER READINGS

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UNIT – 8 OBJECTIVES AND OPERATION OF NUTRITION INTERVENTION PROGRAMMES

Structure

- 8.0 Introduction
- 8.1 Objectives
- 8.2 Nutrition Intervention Programmes
 - 8.2.1 Integrated Child Development Services (ICDS)
 - 8.2.2 Nutrient Deficiency Control Programmes
 - 8.2.2.1 National Prophylaxis Programme for Prevention of Blindness due To Vitamin A Deficiency
 - 8.2.2.2 National Nutritional Anemia Prophylaxis Programme
 - 8.2.2.3 National Iodine Deficiency Disorder Control Programme
 - 8.2.3 Food Supplementation Programmes
 - 8.2.3.1 Applied Nutrition Programme
 - 8.2.3.2 Wheat Based Supplementary Nutrition Programme
 - 8.2.3.3 Special Nutrition Programme
 - 8.2.3.4 Balwadi Nutrition Programme and
 - 8.2.4 Food Security Programmes
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8.0 INTRODUCTION

Nutrition is always considered as the core pillar of human development and can advance the progress of nations by concrete, large-scale programming that reduces the burden of undernutrition and deprivation in countries.

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Adequate food is the foremost basic need and requirement of every human being born in this earth. Right to food is the fundamental right of every individual. The present and future population can be well fed if we take good care of our mother nature considering the abundant resources present in our planet. Yet due to the disorganized population and improper utilization of resources, about 800 million people suffer from chronic undernourishment as per FAO. Undernourishment leads to unhealthy and inactive lifestyle resulting in inability to produce or procure food, which is a vicious cycle, which we have discussed in our earlier units. Hence, it becomes crucial for the Government to formulate strategies to overcome malnutrition. It has been decided and instigated as a policy measure after researches by nutritionist, economist and policy makers that one of the most required and successful measure to alleviate malnutrition is nutrition intervention, while other means like nutrition education, environmental hygiene and home gardening add essence to it.

8.1 OBJECTIVES

After studying this unit you will be able to:

- Enlist the various intervention programmes functioning in the country.
- Explain the objectives, functions and beneficiaries of each program.
- Highlight the rationale behind the national nutrition intervention programmes.

8.2 NUTRITION INTERVENTION PROGRAMMES

The nutrition intervention program aims to bring in a favourable change in nutrition related behavior, environmental condition, or aspect of health status for an individual, target group or the community at large. Nutrition intervention is the most important strategy to combat malnutrition.

The launch of nutrition intervention programmes dates back to 1963, with the launch of Applied Nutrition Programme. From then on numerous nutritional intervention programmes were implemented and many are still successful in reducing the rate of malnutrition. Now, let us group the intervention programmes and discuss each one of them in detail.

- Integrated Child Development Services Programme (ICDS) run by the Ministry of Social Welfare for early childhood care and development remains one of the unique and extensive and community outreach programme.
- Nutrient Deficiency Control Programmes, run by the Ministry of Health and Family Welfare for children and adult for commonly prevalent nutritional disorders are National Nutritional Anemia Prophylaxis Programme, National Prophylaxis Programme for

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Prevention of Blindness due To Vitamin A Deficiency, National Iodine Deficiency Disorder Control Programme.

- Food Supplementation Programmes like Applied Nutrition Programme, Wheat Based Supplementary Nutrition Programme, Special Nutrition Programme, Balwadi Nutrition Programme and Composite Nutrition Programme caters to the need of children, pregnant and nursing mothers.
- Food Security Programmes namely Public Distribution System(PDS), Antodaya Anna Yojana, Annapurna Scheme, ensures timely availability and accessibility to food.
- Chief Ministers Noon Meal Programme or Mid-Day Meal Programme and Tamilnadu Integrated Nutrition Project (TINP) are state child welfare programmes pertaining to TamilNadu.

8.2.1 Integrated Child Development Services

ICDS Scheme, launched on 2nd October 1975 in 33 blocks has been extended to around 5500 blocks today and represents one of the world's largest and most unique programmes for early childhood development. It is run by Ministry of Social welfare. ICDS is the foremost symbol of India's commitment to children.

Objectives

ICDS has been initiated with prime motto of providing a holistic development to down trodden children, pregnant and nursing mothers. Specific objectives of ICDS are listed below:

- To improve the nutritional and health status of children in the age-group 0-6 years and adolescents,
- To lay the foundation for proper psychological, physical and social development of the child,
- To reduce the incidence of mortality, morbidity, malnutrition and school dropouts,
- To achieve effective co-ordination of policy and implementation amongst the various departments to promote child development and
- To enhance the capability of the mother to look after the normal health and nutritional needs of the child through proper nutrition and health education.

Goals

- Preventing and reducing under nutrition as early as possible.
- Focusing on reaching children under three years of age.
- An integrated approach to early child development.
- Extending from the centre to family and community.
- Fostering decentralization, flexibility.
- Ensuring equity.

Beneficiaries

- Children up to 6 years
- Pregnant and Lactating mothers

- Adolescent girls
- All women up to 45 years of age.

Programme Components

ICDS is a distinctive programme under which a package of integrated services consisting of

- Supplementary nutrition,
- Immunization,
- Health checkup,
- Referral and
- Non-formal pre-school education and
- Nutrition & health education service
- Adolescent girls' scheme.

What is done under each of the package is discussed.

- Supplementary Nutrition:** By providing supplementary feeding, the gap that exists between the RDA and average intake of children and women belonging to low socio economic group is bridged. All the families in the community are surveyed and the children below 6 years, pregnant and nursing mothers are chosen as beneficiaries and provided with supplementary feeding that contributes to 500kcal and 12-15 gms of protein for children between 6 months to 6years, 800kcal and 20-25 gms of protein for severely malnourished children between 6 months to 6years and 600 kcal with 18-20 gms of protein for pregnant and nursing mothers for 300 days in a year. Weight is monitored periodically and weight for age growth cards maintained helps in growth monitoring and nutrition surveillance.
- Immunization:** The major preventable diseases which cause disability, mortality and morbidity among children and pregnant women are tetanus, polio, diphtheria, pertussis, tuberculosis and measles. Immunization plays a crucial role in preventing these serious diseases.
- Health Check-ups:** The anganwadi workers and staff of primary health centers provide regular health check-ups, record height and weight, monitor immunization, periodical deworming, provide simple medicines for ailments like common cold, cough and skin infections.
- Referral Services:**For cases that require special treatment and prompt medical attention they are referred to nearby hospitals. The anganwadi worker also detects malnutrition or disabilities at a very early stage and all such cases are enlisted in a special register and referred to medical officers.
- Non-Formal Pre-School Education (PSE):** PSE, a component of ICDS, is considered as the backbone of ICDS as it focuses on the holistic development of children up to 6 years of underprivileged groups through the Anganwadi Centers (AWC).The children are exposed to a joyful, natural play environment for three hours a day, with necessary inputs for optimal growth and development, providing a complete foundation for cumulative lifelong learning. AWC is set up in

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every village and a total of 1.4 million AWC are functioning in the country contributing to universalization of primary education, by providing base for primary schooling, offering substitute care to younger sibling thus freeing the elder ones to attend schools.

- f) **Nutrition & Health Education Service:** This is the key element of work of the anganwadi worker and forms part of behavior and communication strategy, directing on building the capacity of women. The women of age group 15-45 years are trained to look after their own health, nutrition and developmental needs of their own and their family through a common focal point called Anganwadi (the courtyard centers) in each of the village/urban slums.
- g) **Adolescent Girls Scheme:** Realizing the multi-dimensional needs of out of school pre-adolescent girls (11-14 years) and with a aim to motivate these girls to join school system, the Government approved implementation of restructured Scheme for Adolescent Girls (SAG). With expansion of the scheme to all the districts of the country, the Kishori Shakti Yojana (KSY) has been phased out. Scheme for Adolescent Girls (AG) to be implemented using the platform of Anganwadi Services of Umbrella ICDS Scheme through Anganwadi Centers (AWCs). The various programmes run for adolescent girls under ICDS to break the intergeneration cycle of malnutrition has been described already in UNIT-VI. Hence, here let us study about the Nutrition Programme for Adolescent Girls (NPAG) and Kishori Shakti Yojanaalone in detail.

This is a centrally sponsored scheme started in the year 2002. This scheme aims to improve nutritional status, create gender awareness and to provide supportive environment of self-development of adolescent girls. The girls who have registered their names in Anganwadi's will receive 6Kg of free food grain i.e. Rice per month per beneficiary.

Objectives

- Improvement of nutritional and health status of girls, reduction in malnutrition, elimination of micro nutrients deficiencies relating to iron, iodine, vitamin A etc. and reduction of chronic energy deficiency.
- Training and equipment of adolescent girls to upgrade home based vocational skills
- Promotion of health, hygiene, nutrition, family welfare, home management and child care.
- Better understanding of their environment related social issues and its impact on their lives.
- Improvement of knowledge for decisions making capabilities.
- Provide information/guidance about existing public services such as Primary Health Centers, Rural Hospitals/CHCs, Post Office, Bank, Police Station, etc.

Beneficiaries

- Adolescent girls of age group 11-19 irrespective of financial status of family.
- Girls between 11-15 years with body weight less than 30 Kg
- Girls between 15-19 years with body weight less than 35 Kg

Kishori Shakti Yojana

Scheme for Adolescent Girls was sanctioned in the year 2010 and was implemented in 205 districts across the country. Later, the expansion and universalisation of the Scheme for Adolescent Girls was done in additional 303 districts in 2017-18 and the remaining districts in 2018-19 with the simultaneous phasing out of Kishori Shakti Yojana (KSY). Thus at present, all districts in the country are covered under Scheme for Adolescent Girls.

Nutrition Component: Each out of school AGs in the age group of 11-14 years registered under the scheme will be provided supplementary nutrition similar to that of pregnant women and lactating mothers under ICDS containing 600 calories, 18-20 grams of protein and micronutrients for 300 days in a year. Nutrition to be given in the form of Take Home Ration (THR) or Hot Cooked Meals (HCM) whichever is feasible. However, if hot cooked meal is provided to them, strict quality standards have to be put in place.

Cost for Nutrition provision: The financial norms will be Rs. 9.5/- per beneficiary per day for 300 days in a year. This would be inclusive of the cost of micronutrient fortification.

Kishori Health Card: These health cards for all AGs shall be maintained at the AWC. Information about the weight, height, Body Mass Index, IFA (Iron and Folate) supplementation, deworming, referral services and immunization etc. will be recorded on the card. The card shall be filled up by anganwadi helper and countersigned by the AWW. The card also carries important milestones of AGs life including mainstreamed back to school and the same shall be marked as and when achieved.

Kishori Diwas: A special day, once in three months, is to be celebrated as Kishori Diwas when general health checkup of all AGs shall be carried out by Medical Officer/ANM. IFA and de-worming to the girls will be provided on this day. Referrals shall also be made on this day, if required. The day can be utilized for imparting Information Education and Communication to community/parents/siblings etc. counseling/ Behavior Change Communication sessions with AGs and their families for promoting good practices, counseling/ motivating the girls to join school, personality development may be organized on this day.

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8.2.2 Nutrient Deficiency Control Programmes

Government of India's initiative to supply commercially prepared vitamins and minerals in required dosages to the vulnerable groups through organised programmes, known as Nutrient Deficiency Control Programmes. The three important nutrient deficiencies namely Vitamin A, Iron and Iodine are alleviated to a great extent through the successful implementation of the nutrient deficiency control programmes. Let us now discuss important aspects of each one of the programmes in detail.

8.2.2.1 National Prophylaxis Programme for Prevention of Blindness due To Vitamin -A Deficiency

A detailed study on Vitamin A deficiency and its concerns, prevention and treatment had been discussed in UNIT-4. Hence, we shall briefly learn about The National Prophylaxis Programme for Prevention of Blindness due to Vitamin A Deficiency.

The National Programme for prophylaxis against blindness due to Vitamin A deficiency was launched in 1970. This programme includes children in the age group 6 months to 5 years, who are given a massive oral dose of 2 lakh I.U. of vitamin A in oil every six months. The vitamin A is readily absorbed and stored in the liver from where it is gradually released for utilization by the tissues. The programme is implemented by the Department of Health and Family Welfare and is an integral part of the maternal and child health programme.

Objectives

- Reduction in the incidence of the problem.
- Prevention of blindness due to vitamin A deficiency.

Beneficiaries

- Children in the age group of 6 months -5 years, particularly from rural, tribal and urban slum areas.

Programme Components

- a) Creating awareness about the importance of preventing Vitamin A deficiency:** Awareness promotion is done among the women's attending Antenatal clinics, immunization session, as well as women and children registered under ICDS programme.
- b) Providing Prophylactic Vitamin A as per the following dosage schedule:**
 - 100000 IU at 9 months with measles immunization
 - 200000 IU at 16-18 months, with DPT booster
 - 200000 IU every 6 months, up to the age of 5 years.

Thus, a total of 9 mega doses are to be given from 9 months of age up to 5 years.

- c) Treatment of Vitamin A deficient children:**

- All children with xerophthalmia are to be treated at health facilities.

- All children having measles, to be given 1 dose of Vitamin A if they have not received it in the previous month.
- All cases of severe malnutrition to be given one additional dose of Vitamin A.

d) Promoting consumption of Vitamin A rich foods:

- Breast feeding including feeding of colostrum is encouraged.
- By increasing local production and consumption of green leafy vegetables and other plant foods those are rich sources of carotenoids such as pumpkin, carrots, papaya, mango, oranges etc.
- Promotion of regular dietary intake of Vitamin A rich foods by all pregnant and lactating women and by children under 5 years of age.
- Creating awareness to include vitamin -A rich foods along with cereals and pulses to a weaning child.
- When economically feasible inclusion of egg, liver, milk and milk products should be encouraged.

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8.2.2.2 National Nutritional Anemia Prophylaxis

Programme

Nutritional anaemia is one of the major health problems affecting women and children in India. Recognizing the importance of prophylactic measures like supplementation with iron and folic acid to prevent the development of overt anaemia, the NNAPP was launched in 1970. The programme is based on daily supplementation with iron and folic acid tablets to prevent mild and moderate cases of anaemia.

Objectives

- To assess the baseline prevalence of nutritional anemia in mothers and young children through estimation of haemoglobin levels.
- To put those mothers and children with low the Haemoglobin levels (less than 10g/dl and 8g/dl respectively) on anti-anaemia treatment.
- To put the mothers with Haemoglobin level more than 10g/dl and children with Haemoglobin more than 8g/dl on the prophylaxis programme.
- To continuously monitor the quality of the tablets, distribution and consumption of the supplements, and to periodically assess the Hb levels of the beneficiaries.
- To motivate and educate the mothers about the advantages of consuming these tablets.

Beneficiaries

Pregnant women, Lactating mothers and Children under 12 years.

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Programme Components

1. The infants between 6-12 months should also be included in the programme as there is sufficient evidence that iron deficiency affects this age also.
2. Children between 6 months to 60 months should be given 20mg elemental iron and 100 mcg folic acid per day per child as this regimen is considered safe and effective.
3. For children (6-60 months), ferrous sulphate and folic acid should be provided in a liquid formulation containing 20 mg elemental iron and 100mcg folic acid per ml of the liquid formulation. For safety reason, the liquid formulation should be dispensed in bottles so designed that only 1 ml can be dispensed eachtime.
4. Dispersible tablets have an advantage over liquid formulations in programmatic conditions. These have been used effectively in other parts of the world and in large scale Indian studies. The logistics of introducing dispersible formulation of Iron and Folic acid should be expedited under the programme.
5. Children 6-10 year old will be provided 30 mg elemental iron and 250 mcg folic acid per child per day for 100 days in a year.
6. Adolescents, 11-18 years will be supplemented 100 mg of elemental iron and 500mcg of folic acid every week. The adolescent girls will be given priority.
7. The current programme recommendations for pregnant and lactating women should be continued i.e. after the 1st trimester of pregnancy, pregnant mothers are given 60mg of elemental iron and 500mcg of folic acid for 100 days.
8. Manifoldmeasures like production of newer products such as double fortified salts, sprinklers and ultra-ricewith iron and folic acid should be explored as an adjunct or alternate iron and folic acid supplementation strategy.

Other intervention strategies like fortification and nutrition education are discussed in unit-4.

8.2.2.3 National Iodine Deficiency Disorder Control Programme

The National IDD control programme implemented in 1992 by Dept. of Health, Govt. of India has aimed at ensuring production and supply of iodised salt at low cost to all goitre endemic areas. The essential components of this NIDDCP includes iodine fortification, monitoring and surveillance, manpower training and mass communication.

Iodine fortification: The main vehicles for fortification of iodine are salt, sugar, wheat flour, bread, milk and water.

Iodised Salt: Salt fortified with potassium iodate at the level of not less than 30ppm at the time of production and not less than 15ppm while consumption has been determined as a measure to control IDD. Iodised salt is an effective, low cost, long term and sustainable solution to reach a large

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scale at risk group as there is low potential for excessive intake and no change in customers' acceptability.

Double Fortified Salt: Due to the co-existence of IDD and iron deficiency anaemia, National Institute of Nutrition has come with a measure of dual fortification of common salt with two micronutrients iodine and iron together. The stability and bioavailability remains unaltered proving this to be a successful preventive measures for overcoming iodine and iron deficiency disorders simultaneously.

Iodised Oil: Intramuscular injection of 1ml of iodised poppy seed oil (lipiodol) providing 480mg of iodine can provide protection from IDD for 2-3 years while oral dose (oriodol) can give protection for 1 year approximately. Iodised oil will be most effective in preventing new cases of cretinism and mental retardation. Iodised oil with safflower oil has been produced successfully by NIN, and is to be into the market soon. The drawback in iodised oil implementation compared to iodised salt is that this is very expensive and requires extensive man power to take the programme to public.

Iodised Water: Control of IDD through iodised water would be an even more simple measure. 150mcg/l of iodine levels in water would help correct IDD.

Iodine Monitoring and Surveillance: This measure requires determination of levels of iodine in water, soil and food, levels of iodine excretion and determination of iodine in iodised salt for quality control. It is not only implementation but the continuous monitoring to check the availability ensures the success of fortification.

Manpower Training: The health care workers involved in the programmes should be well trained emphasising the need and importance of fortification, deficiency conditions and convincing the public so that the outreach of the programme is satisfactory.

Mass Communication: For any health care programme to be successful nutrition education is mandatory. Creating awareness on the signs and symptoms of IDD, educating the role of iodine in cognitive functions of children, goitrogens present in food, alert on foods to included and avoided, encouraging the use of iodised salt will assure success against IDD.

Check Your Progress

1. List the nutrition intervention programmes.
2. Explain the intervention programme for adolescent girls.

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Next, we will discuss the supplementary feeding programmes that have contributed to malnutrition decline.

8.2.3 Food Supplementation Programmes

Food supplementation programmes or supplementary feeding programmes have evolved over the years as short term measures to combat malnutrition through the distribution of food supplements. Some of the intervention programmes are presented below.

8.2.3.1 Applied Nutrition Programme

This is one of the earliest programmes started in the state of Odisha in the year 1963. The programme was later extended to Uttar Pradesh and Tamilnadu. During 1973, it was extended to all the state of the country. The nutritional Education was the main focus and efforts were directed to teach rural communities through demonstration how to produce food for their consumption through their own efforts. Nutrition worth of 25 paise per child per day and 50 paise per woman per day are provided for 52 days in a year. No definite nutrient content has been specified. The idea is to provide better seeds and encourage kitchen gardens, poultry farming, beehive keeping, etc., but this programme does not produced any impact. The community kitchens and school gardens could not function properly due to lack of suitable land, irrigation facilities, and low financial investment. Ministry of Rural development maintains the functioning of this programme in which 20-30 beneficiaries in each centre were provided nutritious food items prepared body building and protective foods and demonstration feedings held for 200 days in a year. The programme aimed at education and training in applied nutrition and related subjects. However with the introduction of other nutrition programmes it is no longer in operation.

Objectives:

- a. Promoting production of protective food such as vegetables and fruits and
- b. Ensure the consumption of body building and protective foods by pregnant and nursing mothers and children.

Beneficiaries:

- a. Children between 2-6 years and
- b. Pregnant and Lactating mothers.

8.2.3.2 Wheat Based Supplementary Nutrition Programme

Ministry of Food places at the disposal of the Department of Women and Child Development about 100 thousand tonnes of wheat from the central reserves annually and that Department, in turn, sub-allocates this wheat among States which utilize the wheat mostly to produce wheat based ready-to-eat nutrition supplements. With the spread of ICDS, this wheat or its products are increasingly being utilized for distribution of supplementary nutrition in ICDS and mid-day-meal programmes. The wheat is supplied to the State Governments by the Food Corporation of India.

Objectives

- The programme aims to enlarge the scope of existing nutrition programme by covering additional beneficiaries' i.e. Pre-school children and nursing and expectant mothers through wheat-based supplementary nutrition.
- Providing supplementary nutrition to children and Popularizing wheat intake.

Beneficiaries

- Children of pre-school age,
- Nursing and expectant mothers in disadvantaged areas with high IMR or particularly in urban slums and backward rural and tribal areas.

Activities: The scheme consists of 2 components, viz. centrally funded component and state funded component.

i) Centrally Funded Component: Under the centrally sponsored WNP, the supplementary food containing 300 calories and 10 grams protein is given to children and 500 calories and 20 grams of protein to expectant and nursing mothers. Assistance at a cost norm of 75 paise per beneficiary per day for 25 days in a month is provided. Out of 75 paise, the GOI contributes 50 paise and the balance 25 paise is borne by the concerned state governments themselves.

ii) State Funded Component: Under this component, the wheat was initially provided to the state governments at a subsidy of Rs. 700 per m.t., to provide supplementary nutrition to the beneficiaries covered by the state government nutrition programmes. From 1989, no subsidy is given to the state governments. The states are, however, now provided wheat at the public distribution system (PDS) rate.

8.2.3.3 Special Nutrition Programme

This programme was launched way back in 1970-71 by the ministry of social welfare for the same target group as in ICDS i.e. children below 6 years age and expectant and nursing mothers. The programme is confined to tribal areas and slums. Main activity under this programme is to provide supplementary feeding to the beneficiaries for 300 days in a year, although some individual initiatives were made in some States to link some other services with supplementary feeding. For example, in early seventies in the small State of Tripura in North Eastern India, a school dropout tribal girl was selected for running the feeding centre, provided with some motivational training and then encouraged to impart pre- school education to the children, teach them simple personal hygiene etc. Tribal communities were exhorted, and they invariably did so, to construct a small hall where the pre-school activities could take place. Under this programme, every child is to receive 300 calories and 8 to 15 gms of protein and every expectant and nursing mother 500 calories and 20 to 25 gms of protein per day. The scheme is implemented through the network of Anganwadi workers under the ICDS and urban areas through the NGO's in the entire seven districts headquarter of the state with 300 feeding days in a year.

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Objectives

- Improve the, nutritional status of preschool children, pregnant and lactating mothers of poor socio-economic groups in urban slums, tribal areas and drought prone rural areas.
- To provide supplementary nutrition.
- To provide health care services including supply of Vitamin A solution and iron and folic acid tablets.

Beneficiaries

The programme caters to preschool children, pregnant and lactating mothers. The beneficiaries are selected on the basis of their socio-economic groups. The pregnant mother in the last trimester and lactating mothers during the first four months are given priority. The malnourished children are also given priority.

8.2.3.4 Balwadi Nutrition Programme

Bal (children) wadi (home or centre) Nutrition Programme is a contemporary of SNP and is being implemented since 1970-71 by the Central Social Welfare Board and national level nongovernmental voluntary organisations, namely, Indian Council for Child Welfare, Harijan Sevak Sangh , Bhartiya Adimjati Sevak Sangh and Kasturba National Memorial Trust. This segment of nutrition programme is thus implemented essentially by non-governmental organisations. The Central Social Welfare Board, which is a semi-government umbrella organization in the field of social work, gives in turn, grants-in-aid to voluntary organisations to actually run the programme and so do the other four national level voluntary organisations, which also extend assistance to various voluntary organisations besides running some centers directly. The supplementary nutrition consisting 300 calories and 10 g of protein per child per day is given for 770 days a year. Apart from nutritional supplementation, the activities for social and emotional development are undertaken at balwadis. The Balwadi worker is the most peripheral worker implementing the programme at the village/community level.

Objectives

- The programme aims to supply about one-third of the calorie and half of the protein requirements of the pre-school child as measure to improve nutritional and health status.

Beneficiaries

- Beneficiaries are pre-school children between the ages of 3 to 5 years.
- Priority is given to children belonging to low income group.

8.2.4 Food Security Programmes

In unit-1 we have discussed that food security should be ensured to overcome malnutrition. The intervention programmes that ensure food availability at all times are Public Distribution System (PDS), Antodaya Anna Yojana and Annapurna Scheme. Let us discuss each one in detail.

8.2.4.1 Public Distribution System (PDS)

The Public Distribution System (PDS), is one of the most efficient system that is run by the Government to ensure food security. More than 4.62 lakh fair price shops or ration shops distributes the food commodities worth Rs.30, 000 crore annually to about 160 million below poverty line families. The central government bears the responsibility of procuring and supply of the food grains namely wheat and rice, sugar, edible oils and kerosene to the State Governments and Union Territories for distribution. Some State Governments and Union Territories also distribute additional items of mass consumption through the PDS outlet at either free of cost or subsidized rates.

8.2.4.2 Antodaya Anna Yojana

Antodaya Anna Yojana was launched in 2000 by the Government of India, for the poorest of the poor, to ensure hunger free India. It is the 5% of our population who are unable to get two square meals a day, constitute the target group of Antodaya Anna Yojana. The beneficiaries are provided 35 kgs of food grains at the rate of Rs.2/- per kg for wheat and Rs. 3/- per kg for rice.

8.2.4.3 Annapurna scheme

The Ministry of Rural Development launched the scheme in 2000-2001, The Annapurna scheme aims at providing food security to meet the requirement of senior citizens. Indigent senior citizens of 65 years of age or above who though eligible for old age pension under the National Old Age Pension Scheme (NOAPS) but are not getting the pension, are covered. 10 kgs of food grains per person per month are supplied free of cost under the scheme. From 2002-2003 it has been transferred to State Plan along with the National Social Assistance Programme comprising the National Old Age Pension Scheme and the National Family Benefit Scheme. The funds for the transferred scheme are being released by the Ministry of Finance as Additional Central Assistance (ACA) to the State Plan and the States have the requisite flexibility in the choice of beneficiaries and implementation.

8.2.5 Mid-Day Meal Programme (MDM)

Tamil Nadu was the first to initiate a massive noon meal programme to children in primary schools during 1962-6, by then Chief Minister K. Kamaraj and later Chief Minister Dr. M.G.Ramachandran on 01.07.1982 upgraded the programme and renamed as Nutritious Food Scheme, now

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known as PuratchiThalaivar M.G.R. Nutritious Meal Programme. By the mid-1980s three States viz. Gujarat, Kerala and Tamil Nadu and the UT of Pondicherry had universalized a cooked Mid-Day Meal Programme with their own resources for children studying at the primary stage by 1990-91 the number of States implementing the mid-day meal programme with their own resources on a universal or a large scale had increased to twelve states.

Mid-Day Meal improves three areas:

1. School attendance
2. Reduced dropouts
3. A beneficial impact on children's nutrition.

The Central Government supplies the full requirement of food grains for the programme free of cost. For its implementation in rural areas, Panchayats and Nagarpalikas are also involved or setting up of necessary infrastructure for preparing cooked food. For this purpose NGOs, women's group and parent-teacher councils can be utilized. The total charges for cooking, supervision and kitchen are eligible for assistance under Poverty Alleviation Programme. In several states, supplementary feeding was assisted by food supplies from Cooperation for American Relief Everywhere (CARE) and World Food Programme (WFP).

Objectives:

The objectives of the mid-day meal scheme are:

- Improving the nutritional status of children in classes I – VIII in Government, Local Body and Government aided schools.
- Encouraging poor children, belonging to disadvantaged sections, to attend school more regularly and help them concentrate on classroom activities.
- Providing nutritional support to children of primary stage in drought-affected areas.

Beneficiaries

Children in the age group of 6 to 14 years.

Programme Components

- 100 gms of food grains (rice or wheat) per child cooked, eggs to be supplied on all working days, 20gms of black Bengal gram and green gram for 4 days a months, 20gms of potato and 100gms of banana once in a week, providing 350-450 Kcals and 20-30g protein per child per day, to meet one third of the daily requirement, at the cost of Rs.2/- per child for 200 working days is distributed through MDM. Variety meals in the menu since 15.8.2014 has gained momentum among students.

8.2.6 Tamilnadu Integrated Nutrition Project

This project located in the Southern State of Tamilnadu, was started sometime in 1980-81 with the World Bank first time extending assistance for nutrition programmes in India. Second phase of the project with a life of six years has started in 1990-91. The target groups in this project are also children up to 6 years of age and pregnant/nursing mothers. Like ICDS,

pre-school education is provided to children in 3 to 6 years group. The project seeks to provide enhanced inputs in the areas of health, communications, training, project management, operations, research, monitoring and evaluation. This project through various surveys and evaluations have shown that, implemented in just one state with strong political and administrative back up, has been able to secure better coordination between nutrition, health and educational services.

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8.2.7 National Nutrition Strategy

Although, various government initiatives have been launched over the years which seek to improve the nutrition status in the country that had been discussed, the concerns regarding malnutrition is persisting despite improvements over the years. It is in this context that the National Nutrition Strategy under NITI Aayog, has been released by the Government of India, is a right in achieving the developmental obligations of the government.

Key features of the Strategy include

- The Strategy aims to reduce all forms of malnutrition by 2022 (short term perspective) and 2030 (long term perspective), with a focus on the most vulnerable and critical age groups.
- Reduction in percentage age of underweight children below 5 years from the present 35.7% to 20.7% by 2022.
- Reduction in prevalence of anaemia in children (6-59 months) from the present 58.4% to 19.5% by 2022.
- Reduction in prevalence of anaemia in women and girls (15-49 years) from the present 53.1% to 17.7% 2022. In a longer term perspective, the strategy will also aim to progressively reduce all forms of undernutrition by 2030.
- The Strategy also aims to assist in achieving the targets identified as part of the Sustainable Development Goals related to nutrition and health.
- To launch a National Nutrition Mission, similar to the National Health Mission. This is to enable integration of nutrition-related interventions cutting across sectors like women and child development, health, food and public distribution, sanitation, drinking water, and rural development.
- A decentralised approach will be promoted with greater flexibility and decision making at the state, district and local levels.
- Further, the Strategy aims to strengthen the ownership of Panchayat Raj institutions and urban local bodies over nutrition initiatives. This is to enable decentralised planning and local innovation along with accountability for nutrition outcomes.
- The Strategy proposes to launch interventions with a focus on improving healthcare and nutrition among children which includes,

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promotion of breastfeeding for the first six months after birth, universal access to infant and young child care (including ICDS and crèches), enhanced care, referrals and management of severely undernourished and sick children, bi-annual vitamin A supplements for children in the age group of 9 months to 5 years, and micro-nutrient supplements and bi-annual de-worming for children.

- Measures to improve maternal care and nutrition includes supplementary nutritional support during pregnancy and lactation, health and nutrition counselling, adequate consumption of iodised salt and screening of severe anaemia, and institutional childbirth, lactation management and improved post-natal care.
- Governance reforms envisaged in the Strategy includes convergence of state and district implementation plans for ICDS, NHM and Swachh Bharat, focus on the most vulnerable communities in districts with the highest levels of child malnutrition, and service delivery models based on evidence of impact.

8.3 NON-GOVERNMENTAL ORGANIZATIONS

A non-governmental organization (NGO) is any non-profit, voluntary citizens' group which is organized on a local, national or international level, for specific causes like social rights, improving health status, provide literacy etc. The main functions include:

- **Supplementing the activities of governmental agencies:** Helps to strengthen the work of Government by lending personnel or contributing funds or equipments or services.
- **Ingenuity:** NGOs or voluntary agencies pioneer in developing new plans or programmes through research for the benefit of mankind.
- **Education:** Aid the government in dissemination of health and value education.
- **Guarding the work of Governmental agencies:** Guide and criticize the work of Governmental agencies.
- **Advancing health legislature:** Mobilise public opinion and amendment to reform health laws for the benefit of whole community.

Here we shall list few NGOs associated with striving to improve community's nutritional status.

8.3.1 Action against Hunger

Action against Hunger was set up in August 2012 with the purpose of eradicating malnutrition and protecting our country's children from hunger. It is an Indian not-for-profit, non-political and non-religious organization registered under Section 25 of the Companies Act, 1956 in Mumbai. The board is composed of representatives from diverse sectors including business, health, academia and diplomacy, with Professor MS Swaminathan as Chairman Emeritus of the Foundation. The organization functions with a small but dedicated team of practitioners. To achieve its mission to end hunger in a systematic and sustainable way, they have developed strong partnerships with various institutions including Ministry of Health and Family Welfare, Department of Women and Child

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Development, Integrated Child Development Services, hospitals and public health institutions, besides other national and international organizations that support our cause. Their approach is:

- To identify and correctly diagnose the most affected children, and treat them using therapeutic food and micronutrients.
- Locally-trained community workers then follow up with home visits to ensure children do not return to an under nourished state.
- Pregnant women and young mothers are educated on the importance of varied nutrition, based on local product availability and affordable local items.
- Undertake awareness-raising campaigns in communities to create an understanding of undernutrition and promote the implementation of nutrition policies at local and national government levels.
- They work towards continuously saving lives while building long-term strategies for self-sufficiency.
- Their global efforts save hundreds of thousands of lives each year, but millions of malnourished children remain in need of lifesaving treatment.

8.3.2 Feed the Children

Feed the children is a non-governmental organization founded in 1979, headquartered in Oklahoma City exist to end childhood hunger. It's the cause upon which they were founded 40 years ago and the one that they continue to fight for each and every day. Feed the Children work with the motto of providing hope and resources for those without life's essentials and to create a world where no child goes to bed hungry. They also work towards:

- To properly nourish and develop all children by age 5 and continue to understand the importance of nutrition throughout their life,
- To provide have access to safe and clean water, proper sanitation, and adequate hygiene resources that promote healthy immune systems and enable the children to develop through adolescence and into adulthood,
- To enroll, feel safe, and complete a high-quality education that promotes lifelong learning; and
- Families will be self-reliant, financially stable, and able to support and strengthen their communities.

8.3.3 World Food Programme (WFP)

World Food Programme is an international community organisation working to end hunger, provide food security, deliver food in case of

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emergencies, and working with communities to improve nutrition and build resilience. The main objectives of WFP in India are:

- World Food Programme works with Govt. of India in reforming the PDS, in order to strengthen the efficiency of PDS by bringing in transparency and accountability.
- WFP is pioneer the micronutrient fortification of mid-day meals. Pilot project of use of rice fortified with iron for noon meal preparation has reduced anaemia by 20%.
- WFP has helped to identify the food insecure areas and to allow for appropriate relief works to be carried out.

8.3.4 Smile Foundation

Smile Foundation is a national level development non- governmental organization directly benefitting over 400,000 children and their families every year, through more than 200 live welfare projects on education, healthcare, livelihood, and women empowerment, in over 950 remote villages and slums across 25 states of India.

8.3.5 Tuberculosis Association of India

The tuberculosis association of India, founded in 1939, has branches in all states of the country.

Functions:

- Organising T.B. seal campaign every year to raise funds, training doctors, health visitors and social workers in anti-tuberculosis work.
- Promotion of health education.
- Promotion of consultation and conferences.
- Management of institutions involved in anti-tuberculosis activities like New Delhi Tuberculosis centre, Lady Linlithgow sanatorium at kasauli, King Edward Sanatorium at Dharampur and Tuberculosis hospital at Mehrauli.

Check Your Progress

3. Write a short note on mid-day meal programme.

4. Describe the first implemented nutrition intervention programme.

8.4 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

1. Integrated Child Development Services Programme (ICDS) run by the Ministry of Social Welfare for early childhood care and development remains one of the unique and extensive and community outreach programme. Nutrient Deficiency Control

Programmes, run by the Ministry of Health and Family Welfare for children and adult for commonly prevalent nutritional disorders are National Nutritional Anemia Prophylaxis Programme, National Prophylaxis Programme for Prevention of Blindness due To Vitamin A Deficiency, National Iodine Deficiency Disorder Control Programme. Food Supplementation Programmes like Applied Nutrition Programme, Wheat Based Supplementary Nutrition Programme, Special Nutrition Programme, Balwadi Nutrition Programme and Composite Nutrition Programme caters to the need of children, pregnant and nursing mothers. Food Security Programmes namely Public Distribution System(PDS), Antodaya Anna Yojana, Annapurna Scheme, ensures timely availability and accessibility to food. Chief Ministers Noon Meal Programme or Mid-Day Meal Programme and Tamilnadu Integrated Nutrition Project (TINP) are state child welfare programmes pertaining to TamilNadu.

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2. Adolescent Girls Scheme: Realizing the multi-dimensional needs of out of school pre-adolescent girls (11-14 years) and with a aim to motivate these girls to join school system, the Government approved implementation of restructured Scheme for Adolescent Girls (SAG). With expansion of the scheme to all the districts of the country, the Kishori Shakti Yojana (KSY) has been phased out. Scheme for Adolescent Girls (AG) to be implemented using the platform of Anganwadi Services of Umbrella ICDS Scheme through Anganwadi Centers (AWCs). Nutrition Programme for Adolescent Girls:

This is a centrally sponsored scheme started in the year 2002. This scheme aims to improve nutritional status, create gender awareness and to provide supportive environment of self-development of adolescent girls. The girls who have registered their names in Anganwadi's will receive 6Kg of free food grain i.e. Rice per month per beneficiary.

Objectives

- Improvement of nutritional and health status of girls reduction in malnutrition, elimination of micro nutrients deficiencies relating to iron, iodine, vitamin A etc. and reduction of chronic energy deficiency.
- Training and equipment of adolescent girls to upgrade home based vocational skills
- Promotion of health, hygiene, nutrition, family welfare, home management and child care.
- Better understanding of their environment related social issues and its impact on their lives.
- Improvement of knowledge for decisions making capabilities.
- Provide information/guidance about existing public services such as Primary Health Centers, Rural Hospitals/CHCs, Post Office, Bank, Police Station, etc.

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Beneficiaries: Adolescent girls of age group 11-19 irrespective of financial status of family, Girls between 11-15 years with body weight less than 30 Kg, Girls between 15-19 years with body weight less than 35 Kg

Kishori Shakti Yojana

Scheme for Adolescent Girls was sanctioned in the year 2010 and was implemented in 205 districts across the country. Later, the expansion and universalisation of the Scheme for Adolescent Girls was done in additional 303 districts in 2017-18 and the remaining districts in 2018-19 with the simultaneous phasing out of Kishori Shakti Yojana (KSY). Thus at present, all districts in the country are covered under Scheme for Adolescent Girls.

Nutrition Component: Each out of school AGs in the age group of 11-14 years registered under the scheme will be provided supplementary nutrition similar to that of pregnant women and lactating mothers under ICDS containing 600 calories, 18-20 grams of protein and micronutrients for 300 days in a year. Nutrition to be given in the form of Take Home Ration or Hot Cooked Meals whichever is feasible. However, if hot cooked meal is provided to them, strict quality standards have to be put in place.

Cost for Nutrition provision: The financial norms will be Rs. 9.5/- per beneficiary per day for 300 days in a year. This would be inclusive of the cost of micronutrient fortification.

Kishori Health Card: These health cards for all AGs shall be maintained at the AWC. Information about the weight, height, Body Mass Index, IFA (Iron and Folate) supplementation, deworming, referral services and immunization etc. will be recorded on the card. The card shall be filled up by anganwadi helper and countersigned by the AWW. The card also carries important milestones of AGs life including mainstreamed back to school and the same shall be marked as and when achieved.

Kishori Diwas: A special day, once in three months, is to be celebrated as Kishori Diwas when general health checkup of all AGs shall be carried out by Medical Officer/ANM. IFA and de-worming to the girls will be provided on this day. Referrals shall also be made on this day, if required. The day can be utilized for imparting Information Education and Communication to community/parents/siblings etc. counseling/ Behavior Change Communication sessions with AGs and their families for promoting good practices, counseling/ motivating the girls to join school, personality development may be organized on this day.

3. Tamil Nadu was the first to initiate a massive noon meal programme to children in primary schools during 1962-6, by then Chief Minister K. Kamaraj and later Chief Minister Dr. M.G. Ramachandran on 01.07.1982 upgraded the programme and renamed as Nutritious Food Scheme, now known as Puratchi Thalaivar M.G.R. Nutritious Meal Programme. By the mid-1980s three States viz. Gujarat, Kerala and Tamil Nadu and the UT of

Pondicherry had universalized a cooked Mid-Day Meal Programme with their own resources for children studying at the primary stage by 1990-91 the number of States implementing the mid-day meal programme with their own resources on a universal or a large scale had increased to twelve states. Mid-Day Meal improves three areas:

1. School attendance
2. Reduced dropouts
3. A beneficial impact on children's nutrition.

The Central Government supplies the full requirement of food grains for the programme free of cost. For its implementation in rural areas, Panchayats and Nagarpalikas are also involved or setting up of necessary infrastructure for preparing cooked food. For this purpose NGOs, women's group and parent-teacher councils can be utilized. The total charges for cooking, supervision and kitchen are eligible for assistance under Poverty Alleviation Programme. In several states, supplementary feeding was assisted by food supplies from Cooperation for American Relief Everywhere (CARE) and World Food Programme (WFP).

Objectives:

The objectives of the mid-day meal scheme are:

- Improving the nutritional status of children in classes I – VIII in Government, Local Body and Government aided schools.
- Encouraging poor children, belonging to disadvantaged sections, to attend school more regularly and help them concentrate on classroom activities.
- Providing nutritional support to children of primary stage in drought-affected areas.

Beneficiaries: Children in the age group of 6 to 14 years.

Programme Components

- 100 gms of food grains (rice or wheat) per child cooked, eggs to be supplied on all working days, 20gms of black Bengal gram and green gram for 4 days a months, 20gms of potato and 100gms of banana once in a week, providing 350-450 Kcals and 20-30g protein per child per day, to meet one third of the daily requirement, at the cost of Rs.2/- per child for 200 working days is distributed through MDM. Variety meals in the menu since 15.8.2014 has gained momentum among students.

4. Applied Nutrition Programme: This is one of the earliest programmes started in the state of Odisha in the year 1963. The programme was later extended to Uttar Pradesh and Tamilnadu. During 1973, it was extended to all the state of the country. The nutritional Education was the main focus and efforts were directed to teach rural communities through demonstration how to produce food for their consumption through their own efforts. Nutrition worth of 25 paise per child per day and 50 paise per woman per

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day are provided for 52 days in a year. No definite nutrient content has been specified. The idea is to provide better seeds and encourage kitchen gardens, poultry farming, beehive keeping, etc., but this programme does not produce any impact. The community kitchens and school gardens could not function properly due to lack of suitable land, irrigation facilities, and low financial investment. Ministry of Rural development maintains the functioning of this programme in which 20-30 beneficiaries in each centre were provided nutritious food items prepared body building and protective foods and demonstration feedings held for 200 days in a year. The programme aimed at education and training in applied nutrition and related subjects. However with the introduction of other nutrition programmes it is no longer in operation.

Objectives: Promoting production of protective food such as vegetables and fruits and ensure the consumption of body building and protective foods by pregnant and nursing mothers and children.

Beneficiaries: Children between 2-6 years and Pregnant and Lactating mothers.

8.5 SUMMARY

The ultimate objective of all nutrition intervention programmes is to bring about a meaningful and sustained improvement in the well-being and welfare of the people and there is no better index of the well-being of people than the state of their health. The rationale for investing in nutrition is globally well recognized as it is crucial for the fulfilment of human rights, especially of the most vulnerable children, girls and women. It constitutes the foundation for human development, by reducing susceptibility to infections, related morbidity, disability and mortality burden, enhancing cumulative lifelong learning capacities and adult productivity, thereby nation's development too.

8.6 KEY WORDS

- **Mahila Mandal:** Women's group formed to carry out specific activities.
- **Swachh Bharat:** A massive movement that seeks to create a Clean India.
- **Kishori Shakti Yojana:** Scheme for adolescent girls.
- **NITI Aayog:** National Institution for Transforming India.

8.7 SELF ASSESSMENT QUESTIONS

Short Answer Questions

1. Write a short note on ICDS.
2. Explain National Nutrition Strategy.
3. Brief on the intervention programme to prevent Vitamin A deficiency.
4. Discuss the intervention measures to control iodine deficiency disorder.
5. Describe the role of NGOs in alleviating malnutrition.

Long Answer Questions

1. Explain food supplementation programmes.

2. Elaborate on the intervention programmes implemented to prevent nutrient deficiency prevention.
3. How do food security programmes prevent malnutrition?

*Objectives and Operation
Of Nutrition Intervention
Programmes*

8.8 FURTHER READINGS

- Scheme for Adolescent Girls– Administrative Guidelines 2018.
- National Vitamin-A Prophylaxis Program, National Health Portal of India.
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BLOCK-III: ORGANIZATIONS CONCERNED WITH MALNUTRITION AND NUTRITION EDUCATION

UNIT-9 NATIONAL ORGANIZATIONS CONCERNED WITH FOOD AND NUTRITION

Structure

- 9.0 Introduction
 - 9.1 Objectives
 - 9.2 National Organisations
 - 9.2.1 ICMR
 - 9.2.2 ICARM
 - 9.2.3 CHEB
 - 9.2.4 CSWB
 - 9.2.5 SSWB
 - 9.3 Answers to Check Your Progress Questions
 - 9.4 Summary
 - 9.5 Key Words
 - 9.6 Self-Assessment Questions
 - 9.7 Further Readings

9.0 INTRODUCTION

In previous units we have discussed the nutrition intervention programmes that are implemented to overcome malnutrition. Those intervention strategies are mostly executed by the different Departments of Central or State Government. It is highly impossible for the government to get directly involved in all these welfare programmes, hence has constituted organisations to take care of health concerns. At times certain organisations run without the support of Government, but they support the government in improving health status of community as we have discussed under unit -8, Non-Governmental Organisations. In this unit we shall study about the national organisations concerned with food, nutrition and nutrition interventions to warfare malnutrition.

9.1 OBJECTIVES

- After studying this unit you will know
- The different national organisations involved in health care activities.

- Increase understanding of health care systems organization, their historical development and respective functions.
- Be able to describe scope of activities of health organizations on different level.
- The contributions of the organisations so far in community health promotion.

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9.2 NATIONAL ORGANISATIONS

The health care organization, is the organization of people, institutions, and resources that deliver health care services to meet the health needs of target vulnerable populations. Health care is the total societal effort, organized or not, whether private or public, that attempts to guarantee, provide, finance, and promote health. Health care consists of measures, activities and procedures for maintaining and improvement of health and living and working environment, prevention and control of the diseases, injuries and other disorders of the health; early detection of the diseases and conditions of the health, timely and efficient treatment and rehabilitation, by application of professional medical measures, activities and procedures. Delivery of health care services involves the efforts that assist individuals not only in regaining health, but also in preventing disease and disability. Let us discuss each of the organisations in detail.

9.2.1 Indian Council of Medical Research

Indian Council of Medical Research (ICMR), New Delhi as headquarters, set up in 1911, by the Government of India, as IRFA (Indian Research Fund Association) and renamed as Indian Council of Medical Research in 1949, is presided over by the union health minister. The scientific and technical assistance is provided by the scientific advisory board comprising renowned professionals in all biomedical disciplines.

ICMR is the oldest and largest medical research body mainly concerned with the initiation, coordination, and promotion of biomedical research.

The objectives of ICMR is to:

- Translate research into action for improving the health of the population.
- Generate, manage and disseminate new knowledge on nutrition and health.
- Increase focus on research on the health problems of the vulnerable, the disadvantaged and marginalized sections of the society.
- Harness and encourage the use of modern biology tools in addressing health concerns of the country.
- Encourage innovations and translation related to diagnostics, treatment, methods and vaccines for disease prevention.

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- Inculcate a culture of research in academia especially medical colleges and other health research institutions by strengthening infrastructure and human resource.

The primary functions of ICMR are discharged through its network of 26 national institutes. Intramural and extramural research of ICMR contributes to:

- Evaluation of new drugs, insecticides, vaccines, devices, diagnostic kits and other interventions for all diseases of national health priority along with neglected and regional ones.
- Extensive outreach of health education to every corner of the country, including fertility control and maternal and child health.
- Engender reliable data on the magnitude and pattern of non-communicable diseases, like Cardiac diseases, diabetes and cancer in India.
- Create timely and geographically representative data on the clinical, epidemiological, and pathological features of several diseases like diarrhoeal diseases, tuberculosis, leprosy, cholera, malaria, filiarasis, kala- azar, Japanese encephalitis, polio, vector control, drug toxicology and immune hematology in Indian population.
- ICMR is the only Indian agency conducting surveillance of viral diseases including AIDS.
- Identified the priority areas, conducted research in a multicentre mode and found effective, practical, economically viable and sustainable solutions for the major nutrition related problems affecting people.
- Research on traditional medicine is revived.
- Mental health research is also promoted.
- Nutritive value of Indian Foods and Food Fortification are landmark achievements of ICMR in the field of Nutrition.
- Dietary guidelines for Indians of all age groups has been provided by ICMR, taking into account changing life styles, genetic changes and corresponding nutritional needs. Timely revisions of dietary guidelines are done and recent revision was made in 2010.

ICMR attempts to strengthen indigenous capabilities, promote a broad based balanced cadre of research personnel in the country and develops facilities to handle the present and future health problems. Also, ICMR promotes extramural research through centers for advanced research, National Task Force studies and open ended research project from different non-ICMR institutes across the country. Apart from the research activities, ICMR offers many fellowship programs to encourage human resource development in biomedical research which includes research fellowship,

short term visiting fellowship, short term research studentship, training programs and workshops. Attempts have also been made to strengthen and streamline medical information and communication to meet the growing demands and needs of biomedicine in the community. The journal called “Indian Journal of Medical Research” is published under this council.

Some of the institutes of prominence governed by ICMR are:

- National Institute of Nutrition, Hyderabad
- National Institute of Occupational Health, Ahmedabad
- National Institute of Virology, Pune
- National Institute of Epidemiology, Chennai
- National Institute of Research in Reproductive Health, Mumbai
- National AIDS Research Institute, Pune
- Tuberculosis Research Centre, Chennai
- Genetic Research Centre, Mumbai
- Institute of Cytology and Preventive Oncology, Noida.

9.2.2 Indian Council of Agricultural Research

Indian Council of Agricultural Research (ICAR), an autonomous organization under the Department of DARE (Department of Research and Education), Ministry of Agriculture, Government of India, created as an imperial council of agricultural research on 16 July 1929 and later renamed as ICAR. The headquarters is located in New Delhi and union minister of agriculture serves as its president and plays a pivotal role in developing agricultural technologies, and expertise in attaining self-sufficiency in food. This council is based on the motto “research with a human touch” was mainly established for coordinating, guiding and managing research and education in agriculture.

The objectives of ICAR are:

- To plan, undertake, aid, promote and coordinate education, research and its application in agriculture, animal science, fisheries, agro-forestry and allied sciences (disciplines of ICAR).
- To act as clearing house for research and general information relating to its related disciplines, through the publications and information system and instituting and promoting transfer of technology programmes.
- To provide, undertake and promote consultancy services in the field of research, education, training and dissemination of information in all its disciplines.
- To look into the problems relating to broader areas of rural development concerning agriculture, including post-harvest technology by developing cooperative programmes with other organisations such as the Indian council of social Science Research, Council of Scientific and Industrial Research, Bhaba Atomic Research Centre and State Agricultural Universities.

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- To work to attain the food security and agricultural objectives of the society.

Different Units and Functions of ICAR

- **Crop science:** Located at the ICAR Headquarters, the Division has 6 commodity/subject-specific technical sections, namely, Food and Fodder Crops, Oilseeds and Pulses, Commercial Crops, Seeds, Plant Protection, and Intellectual Property Rights. ICAR has contributed in yellow revolution. A super fine rice hybrid Pusa RH-10 and technology for baby corn production in hills has been standardized.
- **Horticultural science:** The Horticulture (fruits including nuts, vegetables including potato, tuber crops, mushroom, ornamental plants including cut flowers, spices, plantation crops, and medicinal and aromatic plants) has become a key drivers for economic development in many of the states in the country and it contributes 30.4 percent to GDP of agriculture, which calls for technology-led development, where Division of Horticulture of ICAR is playing a pivotal role. The research priorities are for genetic resource enhancement and its utilization, enhancing the efficiency of production and reducing the losses in environment-friendly manner.
- **Agricultural Engineering:** The division is mandated to plan, coordinate, and monitor R&D programs and serve as an information repository in Agricultural Engineering. It is involved in development and demonstration of technologies related to the mechanization of production and post-production agriculture using conventional and non-conventional energy sources and includes mechanization of irrigation and drainage activities; and post-harvest and value addition of agricultural products and by-products.
- **Animal Science:** Animal Science Division of ICAR coordinates and monitors research activities in its 19 Research Institutes and their Regional Centers/Stations. The Division coordinates 7 All India Coordinated Research Projects and 6 Network Research Programmes. In addition, 4 Outreach Programmes and 3 Mega Seed Projects (poultry, sheep, and pig) are also being operated in different parts of the country at different ICAR institutes, State Agricultural, Veterinary Universities, State Animal Husbandry Departments and Non-Governmental Organizations.
- **Fisheries science :** The Fisheries Science Division under the Indian Council of Agricultural Research (ICAR) coordinates and monitor the research and academic programmes in fisheries and aquaculture of five resource-specific fisheries research institutes viz., Central Marine Fisheries Research Institute (CMFRI), Central Inland

Fisheries Research Institute (CIFRI), Central Institute of Fisheries Technology (CIFT), Central Institute of Freshwater Aquaculture (CIFA), and Central Institute of Brackish water Aquaculture (CIBA). The Fisheries Science Division has also initiated network projects on Mariculture and Fish Health Management and coordinating a Consortium Research Platform (CRP) project on 'Genomics' as in-built components of the on-going plan schemes, during the XII plan period. Besides, the Division is also undertaking three Outreach projects viz., Fish feeds, Fish genetic stocks & Nutrient profiling and evaluation of fish as a dietary component.

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- **Agricultural Education:** The Agricultural Education Division, ICAR is involved in strengthening and streamlining of the higher agricultural education system to enhance the quality of human resources in the agri-supply chain to meet future challenges in the agriculture sector in the country. This calls for regular planning, development, coordination and quality assurance in higher agricultural education in India. The division strives for maintaining and upgrading quality and relevance of higher agricultural education through partnership and efforts of the ICAR-Agricultural Universities comprising of State and Central Agricultural Universities.
- **NASF:** National Agricultural Science Fund (NASF), previously known as Indian National Agricultural Research System (INARS) strives to find solutions for the immediate problems of farming as well as keep its competence in technology development in the forefront to meet all continuously emerging anticipated and unanticipated problems. Basic and strategic research and applied research in the frontier areas of agricultural sciences are the 'pacemaker' of technology development. Fully realizing this need, the Government of India decided to establish a national fund for supporting and solving agricultural problems by building partnership of all required expertise available in all disciplines and institutions across the countries and to make India a global leader in research for development.
- **Agricultural Extension:** The front line extension programmes implemented by ICAR include a network of Krishi Vigyan Kendras (KVK) and establishment of agricultural technology.
- ICAR brings out a number of periodicals, newsletters, bulletins and project reports.

9.2.3 Central Health Education Bureau

Central Health Education Bureau, (CHEB) is a part of the national organization, which was created in the year 1956 under DGHS (Director-General of Health Services, the ministry of Health and Family Welfare. It functions to promote health education in the country. It was established

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with the recommendation of the Bhore committee, and the planning commission. CHEB provided guidelines to SHEB (State Health Education Bureau) and also works with WHO, State health directorate, Depts. of education like NCERT, Board of Secondary Education and other national and international agencies to impart health education.

Its goal is to educate the people about health plans and programs, training health professionals, developing and supplying health education materials and to assist other health education agencies, conducting health behavioural research activities, providing technical assistance to government and non-government agencies in the field of health education, developing health education syllabi for different target groups and collaborating with international agencies to promote health education. CHEB offers a diploma course in health education, affiliated with Delhi University

It also provides funds to strengthen health education services in all states. Although it was started with some employees, its growth reached to 7 divisions with trained technical personnel and one administrative division.

In order to achieve the goal of developing and promoting health education in the country, the CHEB has the following objectives:-

1. Interpret the plans, programmes and achievements of the Ministry of Health and Family Welfare.
2. Design guide and conduct research in health behaviour, health education processes and aids.
3. Produce and distribute type health education material in relation to various health problems and programmes.
4. Train key health and community welfare workers in health education and research methods, evolve effective methodology and tools of training.
5. Help schools and teacher training institutes for health education of the school population.
6. Provide guidelines for the organizational set-up and functioning of health education units at the state, district and other levels.
7. Render technical help to official and non-official agencies engaged in health education work and coordinate their programmes.
8. Collaborate with international agencies in promoting health education activities.

The objectives are attained with the support of its five major divisions namely, health promotion and education division, media and editorial division, school and adolescent health education division, training and administrative division.

Now, let us list the functions of each division briefly:

Health Promotion and Education Division: The health promotion & Education division was created in 2005 by incorporating the functions and

activities of Health Education Services division of the bureau. This division is responsible for co coordinating and collaborating health promotional and educational activities with national & international agencies. Directly associates with State Health Education Bureaus for imparting health education in the states. It also celebrates national and International health days through adopting various medias of communication like press advertisement, production of prototype health education materials on the theme and broadcasting and telecasting through Prasar Bharti (AIR, Doordarshan). The HPE division collaborates with WHO to carry out health education & health promotion projects for implementation of health education programs in the country.

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Media and Editorial Division: The Media Division of the Bureau is mainly responsible for producing health education and publicity material for carrying out health education programmes in the country on scientific lines by disseminating the latest and correct information to the people about health and prevention of diseases and thereby creating awareness and motivation among the people for achieving desired changes in health behavior through exhibitions, photo services and preparingscripts for All India Radio and DoordarshanKendras on health Issues of public health interest.

School and Adolescent Health Education Division: The functions of this division include:

- To plan, design, strengthen and review school and adolescent health education in the country.
- To establish and maintain the linkages with the department of Education (Min. of HRD) state education depts.
- To facilitate and provide consultative and advisory services in the state UTs in the field of school and adolescent education.
- To produce instruction materials like teaching aids, guides for teachers on school health education.
- To conduct in-service training for teachers and faculties of teacher training institutions (DIETS).
- To identify the adolescent health educational needs and to facilitate and strengthen health education on major adolescent health problems in the country.

Training Division: Training constitutes a major function of the Bureau. The Training Division of the Bureau came into being in 1964, even though the first training programme had been started in 1960 itself with the help of various specialists available in the Bureau to organize courses for different categories of personnel such as family planning extension educators, District health extension educators, health visitors, nursing superintendents, social workers, social scientists, teachers and medical personnel of the various state health education bureau. In recent years much emphasis is laid on supervised field programmes for the trainees in order to develop

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skills in extension education and to integrate the theoretical aspects of health education with the field operations.

Administrative Division: The administration division of the bureau is essentially a service division for the other divisions of the bureau.

9.2.4 Central Social Welfare Board

The central social welfare board was started on 13 August 1953 to carry out welfare activities for women and children. It is an autonomous body, under the Ministry of Education, the Government of India, designed to formulate social welfare policies, promote social legislation, lay down national priorities to achieve social justice and empowerment, in brief to assist in the improvement and development of social welfare activities for women and children.

The programmes implemented by the board include:

- Socio-economic programmes for needy and destitute women by providing financial assistance to create income generation activities.
- Condensed courses of education and vocational training courses for women and girls above 15 years of age to pass secondary, middle and primary level examinations. Hands on training on vocational activities such as draft designing, computer typing, handloom, stenography and nursery teacher training.
- Awareness generation projects for rural and poor women on various social issues.
- Family counseling centers and voluntary action bureau provide preventive and rehabilitation services to women and children who are victims of family maladjustment.
- Supplementary foods, health education and holiday camps for children between 3 to 5 years belonging to low socio economic group.
- Welfare extension projects for mentally retarded children, socially under privileged children of prostitutes and widows.
- Provide day care centers and hostels for working women and their children.
- Mahilamandal promote and set up social welfare program on voluntary basis.

Thus, the objective of setting up a central social welfare board was to work as a link between government and the people by,

- Running rehabilitation centers and cooperative societies for widows and orphans.
- Educating women to acquire basic skills.
- Organizing family welfare camps.
- Providing hostels for working women with security.
- Operating urban welfare centers in towns for recreational activities.
- Supplying nutrition supplement diet to malnourished mothers and children below 5 years.
- Publishing journals “Samaj Kalyan” in Hindi and “Social Welfare” in English.

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9.2.5 State Social Welfare Board

Social welfare programmes of the Nation are an integral part of planned development in India. For the growth and development of the welfare programme, the country is greatly depending on various organisations engaged in accelerating the social welfare activities.

- The State Social Welfare Board (SSWB) under CSWB, functions to disseminate information of programmes being implemented to the beneficiaries of the state, by CSWB.
- However, the SSWB has no legal power and status in the state.
- The State Social Welfare Board has to formulate on the subject matters dealt with women welfare, child development and handicapped persons, etc.
- State social welfare board is created in each State/ and Union Territories, thus totally 33 SSWB is available in India. Some of the main functions assigned to the SSWB by the CSWB are as follow :-
- To act as a medium for exchanging and passing informations between the communities and the CSWB,
- To call for applications for Grants and recommend and forward them to the CSWB.
- To implement policies and supervise the working of the voluntary Agencies in the state and submit reports and any informations required by the Centre,
- To co-ordinate all the welfare activities under taken by various Departments of State Government to avoid duplication or overlapping.
- To work for the promotion of social voluntary organisations with special reference to the Development of Welfare Services.
- To fully co-operate with the centre in administering the programmes of the rural welfare projects and counselling centre directly through voluntary agencies of the state.
- As a matter of fact, a close look of the function of SSWB reveals that it is a consultation body without legal status in the state and acting as a resource agent to CSWB.

Check Your Progress

- 1. What are the functions of crop science and horticultural science divisions of ICAR?**
- 2. List the programmes implemented by CSWB.**
- 3. Mention the objectives of CHEB.**

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9.3 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

1. Crop science: Located at the ICAR Headquarters, the Division has 6 commodity/subject-specific technical sections, namely, Food and Fodder Crops, Oilseeds and Pulses, Commercial Crops, Seeds, Plant Protection, and Intellectual Property Rights. ICAR has contributed in yellow revolution. A super fine rice hybrid Pusa RH-10 and technology for baby corn production in hills has been standardized. **Horticultural science:** The Horticulture (fruits including nuts, vegetables including potato, tuber crops, mushroom, ornamental plants including cut flowers, spices, plantation crops, and medicinal and aromatic plants) has become a key drivers for economic development in many of the states in the country and it contributes 30.4 percent to GDP of agriculture, which calls for technology-led development, where Division of Horticulture of ICAR is playing a pivotal role. The research priorities are for genetic resource enhancement and its utilization, enhancing the efficiency of production and reducing the losses in environment-friendly manner.

2. Socio-economic programmes for needy and destitute women by providing financial assistance to create income generation activities. Condensed courses of education and vocational training courses for women and girls above 15 years of age to pass secondary, middle and primary level examinations. Hands on training on vocational activities such as draft designing, computer typing, handloom, stenography and nursery teacher training. Awareness generation projects for rural and poor women on various social issues. Family counseling centers and voluntary action bureau provide preventive and rehabilitation services to women and children who are victims of family maladjustment. Supplementary foods, health education and holiday camps for children between 3 to 5 years belonging to low socio economic group. Welfare extension projects for mentally retarded children, socially under privileged children of prostitutes and widows. Provide day care centers and hostels for working women and their children. Mahilamandal promote and set up social welfare program on voluntary basis.

3. Interpret the plans, programmes and achievements of the Ministry of Health and Family Welfare. Design guide and conduct research in health behaviour, health education processes and aids. Produce and distribute type health education material in relation to various health problems and programmes. Train key health and community welfare workers in health education and research methods, evolve effective methodology and tools of training. Help schools and teacher training institutes for health education of

the school population. Provide guidelines for the organizational set-up and functioning of health education units at the state, district and other levels. Render technical help to official and non-official agencies engaged in health education work and coordinate their programmes. Collaborate with international agencies in promoting health education activities.

9.4 SUMMARY

To sum up, the national organisations which we have discussed mainly focus on eradicating gender inequality, lack of education, environmental degradation and providing access to clean water, environmental hygiene and development of holistic health. Most of the organisations are also involved in nutrition and health research, finding the measures for sustaining food security and means to provide quality life to its people.

9.5 KEY WORDS

- **ICMR:** Indian Council of Medical Research
- **ICAR:** Indian Council of Agricultural Research
- **CHEB:** Central Health Education Bureau
- **CSWB:** Central Social Welfare Board
- **SSWB:** State Social Welfare Board

9.6 SELF ASSESSMENT QUESTIONS

Short Answer Questions

1. List the functions of ICMR.
2. Discuss the objectives of ICAR.
3. Write a short note on SSWB.

Long Answer Questions

1. Explain the role of ICMR in promoting health.
2. Elaborate the various units and functions of ICAR.
3. Discuss the functions of various divisions of CHEB.
4. Describe the activities of CSWB and SSWB.

9.7 FURTHER READINGS

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UNIT-10 INTERNATIONAL ORGANIZATIONS CONCERNED WITH FOOD AND NUTRITION

Structure

- 10.0 Introduction
- 10.1 Objectives
- 10.2 International Organisations
 - 10.2.1 FAO
 - 10.2.2 WHO
 - 10.2.3 UNICEF
 - 10.2.4 CARE
 - 10.2.5 AFPRO
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 - 10.2.7 World Bank
- 10.3 Answers to Check Your Progress Questions
- 10.4 Summary
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10.0 INTRODUCTION

Eradication of poverty, malnutrition and food insecurity are the main goals of organisations involved with community development. In unit IX, we have discussed the contributions of national organisations towards sustained growth. In this unit, we shall study the various international organisations that play vital role in health promotion.

10.1 OBJECTIVES

After studying this unit you will be able to

- Discuss the different international organisations involved in health promotion.
- Describe the scope of activities of health organizations on different level.
- Understand the contributions of the organisations in preventing malnutrition.

10.2 INTERNATIONAL ORGANISATIONS

A wide constellation of people and organizations work on nutrition and food security issues. The role of international organization is helping to setup the internal agenda within the organization, mediating political non-violence, providing a platform for political initiatives and acts as a bridge between coalition and formation. The goal of the organisations that work

on the department of food and nutrition are to establish technical norms, provide funding, provide technical assistance, or delivering services.

Within the United Nations system, the various agencies were established with distinct, yet complementary, mandates and were given different, but often overlapping, sectors of action. Thus, WHO and FAO were set up as technical agencies with responsibilities for technical norms and technical assistance, whereas UNICEF was designed to support and deliver services through funding and technical support, and the World Bank was designed to provide funds. Let us study the organisations pertaining to our syllabus in detail.

10.2.1 Food and Agricultural Organization

Food and Agricultural Organisation (FAO) was started on 6th October 1945, with its headquarter in Rome, Italy, under United Nations economic and social council.

It is a notable agency of United Nations that with motto “FIAT PANIS” (let there be bread), that makes their efforts internationally to defeat hunger and to achieve food security. FAO not only serves for developing countries but they are also putting efforts to serve developed countries. FAO acts as a common dais where all other nations can meet up as well as they can argue and debate about the policies.

This is the largest specialized agency in the United Nations Organisation, with 197 member states including European Union. Their basic concept is to have ‘enough food for all’.

The main aim of FAO is to:

- To create a world, in which all children can grow, learn and flourish, develop into healthy, caring active members of the society.
- Help nations raise living standards.
- Improve nutritional status of people of all nations.
- Increase the efficiency of farming, forestry and fisheries.
- Better the condition of rural people.
- Widen the opportunity of all people for productive work.

The aims are achieved by following the Objectives of FAO, which areas follows:

- **Modernization and improvisation of agriculture, forestry and fishing practice.**
 - **Help to eradicate hunger, food insecurity and malnutrition:**FAO works in partnership with governments and other development actors at global, regional and national levels to

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develop supportive policy and institutional environments. It also strengthen countries' capacities to translate their political commitment into concrete action to eradicate hunger, food insecurity and malnutrition worldwide.

- **Make agriculture, forestry and fishing more sustainable:** The global population has been projected to reach over 9 billion by 2050 that will put significant pressure on the different agricultural sectors, including crops, livestock, forestry and fisheries. Producing more with less to save natural resources, improve resilience and increase net incomes means that a need for a clear shift away from current policies and practices towards more sustainable approaches is there. This transition is being mainstreamed through supporting countries to adopt a common vision for sustainable food and agriculture in support of the sustainable developmental goals.
- **Helps to reduce rural poverty:** FAO is helping countries develop and implement evidence-based pro-poor policies, strategies and programmes that promote inclusive growth and sustainable livelihoods, income diversification, decent employment, access to social protection and empowerment of women and men in agriculture and in rural areas, thereby reducing poverty.
- **Enable inclusive and efficient agriculture food system:** Increasing the participation of smallholder farmers and agricultural producers from developing countries in food and agricultural systems is critical to achieving FAO's goal of a world without hunger.
- **Increase the resilience of livelihood from disaster:** Conflict, natural hazards and economic crisis are driving up global hunger, causing extensive human suffering and threatening years of progress in fighting poverty, food insecurity and malnutrition. Up to 80% of those hit by crisis are rural families who rely on agriculture for their survival. As such, FAO seeks to strengthen the resilience of agriculture-based livelihoods against multiple hazards. By bringing together humanitarian and development actions, with a deliberate focus on contributing to sustaining peace, FAO addresses the root causes of hunger while meeting the immediate needs of those affected by crisis.

Departments of FAO

FAO has 8 main departments, which co-ordinate to gratify the functions of FAO.

- 1) Agriculture and consumers protection
- 2) Climate
- 3) Biodiversity

- 4) Land and water department
- 5) Economic and social development
- 6) Fisheries and aquaculture
- 7) Forestry
- 8) Corporate service and technical cooperation.

Functions of FAO

The major functions of the Organisation can be listed as follows:

- Collect, analyze, interpret and disseminate information relating to nutrition, food, agriculture and its derivatives including fisheries, marine products and forestry.
- Scientific, technological, social and economic research relating to agriculture, food and nutrition.
- The improvement of education and administration related to agriculture, food and nutrition.
- Dissemination of public knowledge of nutritional and agricultural license and practice.
- Conservation of natural resources and the adoption of improved methods of agricultural products.
- Improvement of processing, marketing and distribution of food and agricultural products.
- The adoption of policies to the provision of adequate agricultural credit- national and international.
- The adoption of international policies with reference to agricultural commodity arrangement.
- It shall furnish technical assistance to government on request to alleviate poverty and hunger.
- Focus on land and water development, food standards, economic and social policies are also major concerns of FAO.
- Aims to meet the needs of present and future generations through long term strategies and programmes that conserve environment and natural resources, and are also technically appropriate, economically viable and socially acceptable.
- Trains the farmers of Asian countries to use bio pesticides under “Farmer Field Schools”.
- Along with the World Food Programme, help people rebuild their lives, during crisis.

Future Challenges:

Though the achievements of FAO are noteworthy, in the campaign to combat malnutrition, the challenges that lie on the roads of FAO are as follows:

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- To reduce the number of world's people affected by hunger and malnutrition.
- To speed up the development of food production in low income food deficit countries.
- To conserve and protect natural resources.
- To achieve a higher degree of rural equity.
- To strengthen the position of the developing countries in world trade.

10.2.2 World Health Organisation

World health organization is the United Nations' specialized agency for health, came to force on April 7th of 1948, which is celebrated every year as World Health Day. It is an intergovernmental organization and works in collaboration with its member states. WHO is responsible for providing leadership on global health matters, shaping the health research agenda, setting norms and standards, articulating evidence based policy options and providing technical support to countries.

Objectives:

The core and general objective of WHO is "The attainment of highest level of health by all" for which the WHO performs a wide range of tasks that includes the following:

- To act as the directing and coordinating authority on international health activities.
- To widen the spectrum of maternal and fetal health.
- To assist Governments, upon request, in strengthening health services.
- To furnish appropriate technical assistance and, in emergencies, necessary aid, upon the request or acceptance of Governments.
- To stimulate and advance work on the prevention and control of epidemic, endemic, and other diseases.
- To promote, in cooperation with other specialized agencies, where necessary, the improvement of nutrition, housing, sanitation, recreation, economic or working conditions, and other aspects of environmental hygiene.
- To promote and coordinate biomedical and health services research.
- To promote improved standards of teaching and training in the health, medical and related professions.
- To establish and stimulate the establishment of international standards for biological, pharmaceutical, and similar products, and to standardize diagnostic procedures.
- To foster activities in the field of mental health, especially those activities affecting the harmony of human relations.

WHO also proposes conventions, agreements, and regulations and makes recommendations about international nomenclature of diseases, causes of death, and public health practices.

Organization:

WHO is unique among the U.N's specialized agencies as it has its own constitution, governing bodies, membership and budget. WHO consists of three principle organizations that includes world health assembly, executive board and secretariat.

World health assembly: This is the supreme governing body of the WHO, which meets the assembly composed of delegates representing the member states.

Executive board: This has 32 members technically qualified in health field. The main work of the board is to give effective decision and policies to the assembly.

Secretariat: 5000 organization staff are working under this. It consists mainly of physicians, medical scientists, and health administrators. Their main work is to give technical and managerial support for the national health development programmes.

There are six regional headquarters to compensate the need. This includes New Delhi (South East Asia), Brazzaville (Africa), Washington DC (America), Copenhagen (Europe), Egypt (East Mediterranean) and Manila (Western Pacific).

Functions of WHO

- **National Health:** WHO constantly stresses on the importance of national health planning and the need for each country to make best utilization of social resources. The WHO is always ready to serve in case of major natural calamities like floods, famines and earthquakes. The WHO now directs its resources in underdeveloped countries to accelerate the growth of primary health care in rural areas.
- **Supplying Nutritious Food:** Their work in terms of nutrition is growing. They work to develop low cost food for babies and infants, which are rich in protein. It educates the people and encourages the government to educate people about the importance of nutritious foods mainly for mothers because they are involved in selection, preparation and handling of foods. Food based dietary guidelines published as a technical bulletin by WHO expresses the principles of nutrition education in terms of food and reinforces the link between dietary pattern and reduced risk of certain diseases.
- **Research Work:** Conducts medical research program, which includes human reproduction, drug evaluation, pollution and to improve sanitary

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condition. The WHO is studying the different types of medical disorder and their treatment. The main function of WHO is to sponsor the training and research for the medical practitioner of different countries.

- **Collaboration:** The WHO is collaborating with Indian government in the program of medical research in areas of epidemics like cholera, typhoid, occupational health, medical technology. Pathology etc. The WHO supports the cholera research Centre, Kolkata and the National Institute of occupational health, Ahmedabad. WHO is also working closely with the Severe Acute Respiratory Syndrome affected countries to provide clinical, epidemiological and logistical support to eradicate it. Besides, WHO has also established relations with a number of international governmental organisations.
- **Awareness Promotion:** The WHO is involved in nutrition programs by promoting general awareness on the prevalence of deficiencies and supporting the development and application of improved methods of prevention, detection and control of diseases and nutritional problems.
- **Immunization:** Almost all communicable diseases have been the subject of WHO. The global emancipation from small pox is a good example. The WHO is presently involved in the global battle against AIDS. Immunization against common diseases during childhood is given priority in WHO programmes. The WHO provides vaccination for measles, polio and tablets for designing.
- **Health Statistics:** WHO acts as a source of information, by publishing the statistics relating to prevalence, morbidity and mortality for variety of diseases.
- **Environmental Health:** WHO advises nations for provision of basic sanitary services to its people. A number of programmes such as “WHO Environmental Health Criteria Programme” and “WHO Environment Health Monitoring Programme” have been developed to improve the environmental health.
- **Family Health:** One of the major functions of WHO since 1970, is the improvement of family health status, which is provided by maternal and child health care, human reproductive health and nutrition and health education services.

WHO Guidelines on Nutrition:

- Baby- Friendly hospital initiative.
- Supplementation of calcium, daily and intermittent iron and folic acid, Vitamin A in pregnant women.
- Guidelines on HIV and infant feeding 2010.
- Intermittent iron and folic acid supplementation in menstruating women, non- anaemic pregnant women.
- Use of multiple micronutrient powders for home fortification of foods consumed by pregnant women, infants and children 6-23 months of age.

- Consultation on the dietary management of moderate malnutrition in under 5 children

These guidelines are few to mention the interests and focus of WHO to eradicate malnutrition and improve the community nutritional status.

10.2.3 United Nations International Children Emergency Fund

United Nations International Children Emergency Fund (UNICEF), was started by United Nations General Assembly, on 11 December 1946 to provide food and health care to children and mother who were affected in World War II, and in 1953 when the emergency conditions were over, it was renamed as United Nations Childrens' Fund. The main aim of UNICEF is to make whole child by:

- Improving the nutritional status and health of children.
- Improving the environment of the country and providing clean and safe environment for the children to live in.

At present UNICEF works in 161 countries, governed by a thirty nation executive board. UNICEF works in close collaboration with WHO and UNESCO to advocate children's rights and help to meet their needs, to find solutions to the problems of poor children and their families.

Functions of UNICEF

- **Treating Malnutrition:** Across the globe, an estimated 16 million children under the age of 5 are affected by severe acute malnutrition. This number is staggering – most importantly, because children with severe acute malnutrition are nine times more likely to die than well-nourished children. Until relatively recently, these children were only treated in hospitals where they received therapeutic milks along with medical care; and many more were never reached at all. With the creation of ready-to-use therapeutic food (RUTF) by UNICEF, however, the picture has changed dramatically. In 2007, the United Nations endorsed the community-based management of severe acute malnutrition, and since then, millions more children are now being treated and cured globally than with the facility-based approach alone. UNICEF strengthens the capacities of national governments and local actors to scale-up treatment for severe acute malnutrition in over 75 different countries. This includes supporting governments to institutionalize treatment programmes through national planning mechanisms and policy changes. UNICEF gathers global data and captures lessons learned to update treatment approaches and protocols, and provide guidance to improve the coverage and quality

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of programmes. A key example is the UNICEF Management of Severe Acute Malnutrition Programme Guide, which provides guidance on programme assessment, design, planning and implementation.

- **Preventing Micronutrients Deficiencies:** Micronutrients are essential components of a high-quality diet and have a profound impact on health. Micronutrient deficiencies are often referred to as 'hidden hunger' because they develop gradually over time, their devastating impact not seen until irreversible damage has been done. The main micronutrient deficiencies are iodine, iron, vitamin A, folate, calcium and zinc. UNICEF uses community-based approaches to promote breastfeeding, improve complementary feeding and encourage consumption of a diverse range of locally available foods. To reduce child mortality, UNICEF supports vitamin A supplementation programmes for children aged 6-59 months in priority countries (the countries which have high mortality rate of under five children). UNICEF advocates and guides national governments and private sector salt producers in implementing universal salt iodization. UNICEF also supports national governments to develop food fortification programmes for vitamin A, iron and folic acid.
- **Ameliorating Breastfeeding and Complementary feeding:** Breast milk provides the ideal nutrition for infants. Breastfeeding lowers the baby's risk of having asthma or allergies and also, babies who are breastfed exclusively for the first 6 months, without any formula, have fewer ear infections, respiratory illnesses, and bouts of diarrhea. The foods consumed between 6 months and 2 years of life are called complementary foods because they ideally complement an already breastmilk-based diet, and the 18 month period between 6 months and age 2 is referred to as the complementary feeding period. UNICEF and WHO are leading a global partnership to galvanize political commitment and investments to increase breastfeeding rates. UNICEF also works with governments to develop and enforce policies that provide time, space, and support for women to breastfeed. UNICEF and WHO have developed an integrated course on infant and young child feeding, including supportive supervision to build the capacity of health workers to better counsel and support mothers. UNICEF works with communities to establish counselling opportunities for mothers to adopt appropriate feeding practices. UNICEF provides caregiver nutrition education to improve complementary feeding. In settings plagued by food insecurity, UNICEF promotes the use of fortified foods and micronutrient powders to improve the nutrient quality of complementary foods. The active ongoing programmes Baby Friendly Hospital Initiative and International Code of Marketing of Breastmilk Substitutes of UNICEF emphasizes the importance of infant health.

- **Supportive Nutrition for HIV/AIDS:** HIV continues to be a major global public health issue, having claimed more than 32 million lives so far. In 2018, 770 000 people died from HIV-related causes globally. There were approximately 37.9 million people living with HIV and 1.7 million people becoming newly infected with HIV in 2018 globally. UNICEF helps train health and community workers to prevent mother-to-child transmission of HIV, and to support safe breastfeeding. UNICEF supports provider initiated voluntary, confidential HIV testing to women throughout pregnancy, at delivery, and during the breastfeeding period. UNICEF provides support for nutritional assessments and counselling to manage HIV disease and the side effects of antiretroviral drugs. UNICEF also supports therapeutic feeding, together with antiretroviral therapy, for children living with HIV and suffering from severe acute malnutrition.
- **Emergency Health Care:** UNICEF's largest programmes are in countries that experience frequent humanitarian crisis, to prevent death from starvation and disease and to reduce malnutrition by supporting therapeutic and supplementary feeding, providing essential micronutrients and feeding orphans.
- **Improving Maternal Health:** Improving the nutritional status of pregnant women is essential to reduce maternal deaths, miscarriage, still birth and low birth weight. UNICEF focuses on the need to improve the status of women and to provide adequate nutrition, care and rest during pregnancy and nursing. UNICEF also strives to prevent low birth weight in infants by the Low Birth Weight Prevention Initiative.
- **Monitoring Infant Growth Rates:** UNICEF supports growth monitoring in health facilities and communities in more than 40 countries, generating that is used by the immediate care takers and local health workers to access child growth, analyze causes of the problems if any exist and determining necessary action.

Also, we have discussed about GOBI, an initiative by UNICEF, in preventing malnutrition in Unit 3.

- UNICEF has launched 3F strategy- Fertility regulation, Female literacy and Food supplementation to enhance women health and overcome malnutrition.
- In cooperation with FAO, UNICEF has set up 200 milk processing plants in 41 countries.
- Fish farming, poultry raising, home gardening, digging of wells, testing of

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protein mixtures, iodisation of salt are some of the programmes supported by UNICEF.

• Along with UNESCO, UNICEF has assisted India in expansion and improvement of teaching, especially in promoting girl child education.

Check Your Progress

1. List the aims of FAO.
2. Explain the objectives of WHO.
3. Mention the aims of UNICEF.

10.2.4 Cooperative American Relief Everywhere (CARE)

CARE was founded in 1945 to provide relief as an emergency response for the survivors of World War II, and help people rebuild their lives. Now CARE is a leading humanitarian organization which fights poverty, globally. CARE is a body of 10 autonomous member organization, operating in more than 70 countries. CARE is a signatory of major international humanitarian standards and codes of conduct including the code of conduct for international Red Cross and Red Crescent movement and non-governmental organization disaster relief.

Women are at the heart of CARE'S community based efforts to improve basic education, prevent the spread of HIV, increase access to clean water and sanitation, expand economic opportunity and protect natural resources.

One of CARE'S goal is to improve the food security of poor families. Since 1982, CARE has been an active supporter of the Indian Government Integrated Child Development Services programmes, a nutrition and health programmer that serve millions of poor women and children. CARE helps strengthens the capacity of ICDS anganwadicenters, to provide basic services that include the management of diarrhea and respiratory infections, immunization, growth monitoring, health and nutrition education with vitamin A supplement. The pillar of CARE programming in India will be INHP (Integrated Nutrition and Health Programme), which targets feeding mothers and children under the age of two. CARE generated money from public and international organization.

The objectives of CARE are:

- To strengthen capacity for self-help.
- To provide economic opportunity.
- To deliver relief in emergencies.
- To influence policy decisions at all levels.
- To address discrimination in all its form.

The main activities of CARE include:

• **Responding to Emergencies:** They support emergency relief as well as prevention, preparation and recovery program. In 2016, CARE reportedly reached more than 7.2 million people through its humanitarian respond. CARE'S core sector for emergency response are food security, shelter and sexual and reproductive health.

- **Education:** CARE pays special attention to girl child education, who make up the majority of children out of school.
- **Women Health:** CARE directly works with women and communities empowering them with resources and information to ensure that safe pregnancy and birth are basic human rights. CARE has given priority on reducing maternal mortality rates.
- **Expanding Economic Opportunity:** CARE helps women and families expand their income through increased access to financial and non-financial services participation in village savings and loan associations, market linkages and diversified livelihoods.
- **Ending Gender Based Violence:** CARE includes gender equity in all its programmes. CARE also advocate laws and policies to better protect and empower women. CARE places special emphasis on gender equality and women's empowerment in climate change work since women suffer disproportionately from climate shock.
- **Enhancing Water Access, Use and Management:** CARE helps and urges communities to build and maintain water systems and latrines. The goal of this initiative is to reduce health risks of water related diseases and to inculcate hygiene and sanitation in everyday life and reduce the burden of communicable diseases.

Assistance of CARE in India: The different projects undertaken by CARE in India include:

- Integrated Nutrition and Health Project (INHP)
- Promoting Linkage for Urban Sustainable Development (PLUSD)
- Better Health and Nutrition Project (BHNP)
- Sustainable Tribal Empowerment Project (STEP)
- Anaemia Control Programme
- Credit Relation for Empowerment and Development through Institution Building and Training Project (CREDIT)
- Maternal and Infant survival Project (MISP)
- Girls Primary Education Project (GPEP)
- Improving Women's Health Project
- Improved Health Care for Adolescent Girls Project
- Konkan Integrated Development (KID) Projec
- Child Survival (CS) Project
- Improving Women's Reproductive and Family Spacing Project.

10.2.5 Action for Food Production

Action for Food Production (AFPRO), is a non-governmental organization with a prominent national presence. It was created in 1966, with Christian inspiration, as a secular Indian technical service organization. It was then registered in 1967 under the societies registration act XXI of 1860, and is celebrating 52 years in service of poor.

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Their multidisciplinary technical service and capacity development support represent an evolution in approaches adopted. Competent terms comprising of hydro geologist, civil and agricultural engineering, agriculture and livestock specialist and rural sociologies have been contributing to the design, development and implementation of innovative technological solutions addressing limiting factor and their grassroots.

The aim of AFPRO is development of weaker sections of rural community and to move towards sustainable development through overall increase in their knowledge and skills, in the areas which directly affect their standard and quality of life.

Focus of AFPRO: AFPRO dedicates itself to its mission of alleviating rural poverty by promoting and working through voluntary organizations; with a focus on enabling the marginalized and weaker sections of rural society to participate in the process of rural development by strengthening their resource base and capabilities through improved knowledge and skills, both in the technical and socioeconomic development areas.

Main Approaches

- AFPRO's target group is poor and marginalized communities. They work with them for the sustainability of interventions.
- In the 1960's and 1970's, AFPRO focused extensively on the scientific development of groundwater for drinking and irrigation, pioneering the yield test technology in some of the most challenging geological conditions in the country (hard rocks of peninsular India). This included an estimation of groundwater potentials, assessments of the efficiency of wells and performance of aquifers.
- Cattle breeding programmes were designed to exclusively transfer high yielding varieties of breeds with the objective of strengthening rural livelihoods.
- In the 1980's, land and water resources conservation efforts were initiated in the state of Maharashtra, where, the development of land and water included the design of simple soil and water conservation measures, which led to the gradual evolution of what is now known as the 'watershed' approach.
- Development of renewable sources of energy, where improvements in existing biogas plants were made with the intention to make the technology affordable to the common man and led to the development of a model known as the Deenbandhu Biogas Model.
- In the 1990's, sustainable agriculture took centre stage with an emphasis on promotion of simplest forms of agriculture and livestock husbandry. This includes support to the marketing of agricultural produce, its post-harvest management and development of supply chains. A marked shift was the transformation from a Technical Development Organization to a Socio-Technical

Development Organization, which was backed by sensitization to social and gender issues. Technical specialists were trained in participatory processes of planning and implementing natural resource management programmes.

- Environmentally as well as economically chemical pesticides are proven to be costly. So farmers have more debts to pay due to increased input costs and health problems. So AFPRO, has tried to help them with rainwater harvesting, biogas technology and trying to sort out the requirement of water, to balance it's need and availability.
- During 2000s, AFPRO focused on impact of climate change on agriculture and climate change adaptation programmes.

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10.2.6 Church World Service (CWS)

Church world service (CWS) was founded in 1946. It is a cooperative ministry of 37 Christian denominations and communion providing sustainable self-help, development, disaster relief and refugee assistant around the world. The CWS's mission is to eradicate hunger and poverty and to promote peace and justice at the national and international level through collaboration with partners abroad and in the United States. CWS works with communities to overcome the root causes of hunger. Access to land to grow food is essential for both indigenous communities, long denied right to their ancestral lands as well as to the women smallholder farmers, who grow the vast majority of food consumed around the globe. Ensuring proper nutrition in the first 1,000 days of a child's life is key to their healthy growth and realizing their full potential later in life. CWS work with communities to find ways to feed themselves sustainably and nutritiously.

Activities of CWS

- CWS program mainly target education area and advocacy which are the important components in confronting the root causes of hunger.
- They raise awareness about hunger, poverty, water access, trade, Human Rights, climate change and peace building.
- When disasters strike, CWS works with partners to provide shelter, food and water, blankets, counselling for survival etc.
- Aim to provide rural communities – especially women and youth – with access to technical assistance, training and economic opportunities.
- Programs designed to help increase food security and household income through better home gardening and poultry raising. Community information sessions about nutrition, sanitation,

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hygiene, sanitary latrine use and safe water led to improvements in family wellbeing, especially for children.

- Assisting refugees and immigrants in achieving food security.
- CROP hunger walks - CROP Hunger Walks are community-wide events sponsored by CWS and organized by local congregations or groups to raise funds to end hunger at home and around the world.

10.2.7 World Bank

The World Bank (WB) , was started in July 1944, as a specialized agency of United Nations with the motto “working for poverty free world”. It’s headquarter is in Washington DC. The World Bank is an international financial institution that provides interest-free loans and grants to the governments of poorer countries for the purpose of pursuing capital projects. The World Bank is guided by commitment to promote foreign investment, international trade and facilitate capital investment. It comprises two institutions: The International Bank for Reconstruction and Development (IBRD) with 188 member countries, and The International Development Association (IDA) with 172 members.

The mission to end extreme poverty and promote shared prosperity in a sustainable way is achieved by:

The goals of World Bank are as follows:

- World Bank helps the war-devasted countries by granting loans for reconstruction. Thus, they provide extensive experience and the financial resources of the bank help the poor countries increase their economic growth, reducing poverty and a better standard of living.
- Also, WB helps the underdeveloped countries by granting development loans.
- Provides loans to various governments for irrigation, agriculture, water supply, health, education, etc.
- Promotes foreign investments to other organizations by guaranteeing the loans.
- World Bank provides economic, monetary, and technical advice to the member countries for any of their projects. Thus, it encourages the development of industries in underdeveloped countries by introducing the various economic reforms.

Purposes of the World Bank

- Create an environment that is a pro-investment.
- Improve the stability by reducing poverty. So, it is working towards achieving sustainable growth.
- Increasing the opportunities for jobs and business in member nations which are underdeveloped.
- Through investment, WB plans to promote the socio-economic status of the society.

- Ensure that the judicial and legal systems are developed and individual rights are protected.
- Strengthening the government of its member nations by promoting education.
- Combating corruption and to ensure that there are adequate training opportunities and research facilities.
- Provide loans with low-interest rates and interest-free credits.

Check Your Progress

4. What are the aims of CARE?

5. Explain the aim and focus of AFPRO.

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10.3 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

1. The main aim of FAO is to:

- To create a world, in which all children can grow, learn and flourish, develop into healthy, caring active members of the society.
- Help nations raise living standards.
- Improve nutritional status of people of all nations.
- Increase the efficiency of farming, forestry and fisheries.
- Better the condition of rural people.
- Widen the opportunity of all people for productive work.

2. The core and general objective of WHO is “The attainment of highest level of health by all” for which the WHO performs a wide range of tasks that includes the following:

- To act as the directing and coordinating authority on international health activities.
- To widen the spectrum of maternal and fetal health.
- To assist Governments, upon request, in strengthening health services.
- To furnish appropriate technical assistance and, in emergencies, necessary aid, upon the request or acceptance of Governments.
- To stimulate and advance work on the prevention and control of epidemic, endemic, and other diseases.
- To promote, in cooperation with other specialized agencies, where necessary, the improvement of nutrition, housing, sanitation, recreation, economic or working conditions, and other aspects of environmental hygiene.
- To promote and coordinate biomedical and health services research.
- To promote improved standards of teaching and training in the health, medical and related professions.

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- To establish and stimulate the establishment of international standards for biological, pharmaceutical, and similar products, and to standardize diagnostic procedures.
- To foster activities in the field of mental health, especially those activities affecting the harmony of human relations.

3. The main aim of UNICEF is to make whole child by: Improving the nutritional status and health of children, improving the environment of the country and providing clean and safe environment for the children to live in.

4. The objectives of CARE are:

- To strengthen capacity for self-help.
- To provide economic opportunity.
- To deliver relief in emergencies.
- To influence policy decisions at all levels.
- To address discrimination in all its form.

5. The aim of AFPRO is development of weaker sections of rural community and to move towards sustainable development through overall increase in their knowledge and skills, in the areas which directly affect their standard and quality of life. **Focus of AFPRO:** AFPRO dedicates itself to its mission of alleviating rural poverty by promoting and working through voluntary organizations; with a focus on enabling the marginalized and weaker sections of rural society to participate in the process of rural development by strengthening their resource base and capabilities through improved knowledge and skills, both in the technical and socioeconomic development areas.

10.4 SUMMARY

To summarize, the international organisations play a pivotal role on eradicating poverty and malnutrition since World War II. Most of the organisations are part of United Nations and are closely associated with nutrition and health research, alleviating food insecurity and providing education especially for women and girl children.

10.5 KEY WORDS

- **FAO** : Food and Agricultural Organization
- **WHO** : World Health Organization
- **UNICEF** : United Nations International Children Emergency Fund
- **CARE** : Cooperative American Relief Everywhere
- **AFPRO** : Action for Food Production
- **CWS** : Church World Service

10.6 SELF-ASSESSMENT QUESTIONS

Short Answer Questions

1. List the functions of FAO.
2. Discuss the role of AFPRO in building healthy communities.
3. Mention the purpose of existence of World Bank.
4. Explain the activities of CARE.

Long Answer Questions

1. Explain the objectives of FAO.
2. Elaborate on the functions of WHO.
3. Discuss the functions of UNICEF in alleviating malnutrition.

10.7 FURTHER READINGS

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UNIT-11 NUTRITION EDUCATION

Structure

- 11.0 Introduction
- 11.1 Objectives
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 - 11.2.1 Definition
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11.0 INTRODUCTION

In all the units discussed so far, we have seen the prevalence of malnutrition, impact of malnutrition, various intervention programmes initiated by Government, Non-Governmental Organisations both at national and international levels. You must have noticed that whatever the preventive or treatment measures we have studied, for any nutritional deficiencies, it has highlighted nutrition education as one of the prime protective means. Hence, it is important to discuss about nutrition education, its importance and training of the persons who meet the public to transfer the knowledge and all these aspects are dealt in this unit.

11.1 OBJECTIVES

After studying this unit you will be able to:

- Define nutrition education.
- Explain the nature and importance of nutrition education to the community.
- Understand the concept of training nutrition educators.

1.2 NUTRITION EDUCATION

Nutrition and health education are important along with other factors to promote optimal nutrition. Only through education and awareness promotion on healthy diets, many food and diet related non-communicable diseases like obesity, diabetes, cardiac diseases and cancer can be prevented to great extent, as the main contributory factors for these conditions are associated with dietary patterns like too much consumption of junk foods made of refined ingredients providing only empty calories, too much of saturated fats, lack of fibre and sedentary life style. It is highly possible to overcome by providing nutrition education from childhood days through school curriculum and educating mothers. In this unit we shall study what nutrition education means, its importance and how to train the educators to succeed in providing education.

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11.2.1 Definition

Nutrition education in the lines of different authors or organisations is depicted below:

- Nutrition education is defined as instruction or training intended to lead to acquired nutrition-related knowledge and/or nutrition-related skills and be provided in individual. (ADA, 2011)
- Nutrition education is a set of planned educational activities targeted at certain population groups and aimed at acquiring healthy nutrition behaviors. (Gil, 2010)
- Nutrition education is a process that helps individuals, families, and communities make informed choices about food and lifestyles that support their physiological health, economic, and social well-being. (USDA, 2012b)
- Nutrition education is any combination of educational strategies, accompanied by environmental supports, designed to facilitate voluntary adoption of food choices and other food- and nutrition-related behaviors conducive to health and well-being. Nutrition education is delivered through multiple venues and involves activities at the individual, community, and policy levels. (Contento, 2011)
- The aim of health education as defined by World Health Organisation is to help people to achieve health by their own efforts. They must be motivated to change their habits and ways of living. It aims at breaking down barriers of ignorance, prejudice and misconceptions and providing learning experiences, which favorably influence dietary habits, attitudes and knowledge relating to individual family and community health. Thus, Nutrition Education can also be defined on the similar lines, as the process of acquainting people with the value of resources already available to them and persuading them to change existing practice. In other

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words educating for better nutrition and thus bringing the desirable positive changes in knowledge, attitude and practice in order to enhance the nutritional status of the individual and community as a whole.

- Nutrition education is a process of applying a knowledge of nutrition related scientific information and social and behavioral sciences in ways designed to influence individuals and groups to eat the kinds and amounts of food that will make a maximum contribution to health and social satisfaction’.
- Nutrition education may be defined as a group of communication activities aimed to bring about a voluntary change in practices, which have an effect on the nutritional status of a population. Thus, the term ‘nutrition education’ applies to any communication system that teaches people to make better use of available food resources with the ultimate goal of improving nutritional status.

11.2.2 Nature and Importance to the Community

First, we shall try to understand the need and importance of nutrition education, so that it will be easier to comprehend the nature of imparting education to the community.

Importance of Nutrition Education

Nutrition education offers a great opportunity to individuals to learn about the essentials of nutrition for health and to take steps to improve the quality of their diets and thus their well-being. It is the process of teaching the science of nutrition to an individual or group. The early beginning of modern nutrition education can be traced to the early attempts to prevent protein energy malnutrition (PEM) in infants and children, primarily due to faulty weaning practices.

The need for nutrition education evolved about half a century ago when in 1950, the first report of the joint FAO/ WHO expert committee on nutrition, recognized the need for nutrition education in developing countries. In 1958, this committee reported that “Education in nutrition is a necessary part of practical programmes to improve human nutrition” and recommended the channels for nutrition education are schools, maternal child health (MCH) centers, community development and related programmes. In 1978, the Nutrition Education and Training (NET) program was created by the USDA, with the purpose of giving grants to help fund nutrition education programs under state educational systems. Funding for the program was targeted towards school children, teachers, parents, and service workers.

Nutrition education is delivered through multiple venues and involves activities at the individual, community, and policy levels. Nutrition education also critically looks at issues such as food security, food literacy and food sustainability.

Thus, the nutrition education is important to:

- a. To create positive attitudes toward good nutrition and physical activity.
- b. To provide motivation for improved nutrition and lifestyle practices conducive to promote and maintain the best attainable level of wellness for an individual.
- c. To provide adequate knowledge and skills necessary for critical thinking regarding diet and health so the individual can make healthy food choices from an increasingly complex food supply.
- d. To assist the individual to identify resources for continuing access to sound food and nutrition information.
- e. The need for nutrition education has been strongly reinforced by the concept of the Right to Food. The public requires information and training to recognize their food rights and to learn how to participate in decisions that affect them.
- f. To provide information and education on good diet, food safety, food-borne diseases, food labelling and processing, production and preparation; while in the school curriculum integrating agriculture, food safety, environment, nutrition and health education builds citizens' capacity to achieve and maintain their own food security. Hence nutrition education is an essential vehicle for establishing food rights.
- g. To educate on good family and complementary feeding through sharing knowledge and skills on how to optimize the use of locally available foods, so that maternal and child feeding practices can be improved.
- h. Nutrition education provided at elementary level lays a strong foundation for promoting lifelong healthy eating and improving long-term, sustainable nutrition security.
- i. To educate about the use of locally available and seasonal foods, and highlighting that optimal nutrition need not be expensive always. For instance, most mothers are not so poor as not to be able to afford 50-100 gms of green leafy vegetables to child daily, if they realize that this may make a difference between blindness and normal vision.
- j. Nutrition education is important to enhance and enrich knowledge and corrects faulty concepts of nutrition. As an example, cooked pulses that are high in protein. But, weaning infants often are not fed dal out of fear that it will produce flatulence and illness.
- k. Nutrition education is an essential means to ensure better health practices and food habits through an increase knowledge and favorable attitudes. This includes changes in the breast feeding and weaning practices following diarrhea.
- l. To improve the nutritional levels of the community by wise use of the available means that control malnutrition.
Hence, nutrition education is of crucial importance as the problem of ignorance, ill-health and malnutrition go in hand. Therefore, such

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education is probably greatest and most urgent need of the hour for the vulnerable sections of the community to reach the heights of optimal health.

Check Your Progress

1. Define Nutrition Education (any 2)

2. List the importance of Nutrition Education.

Nature of Nutrition Education

Having known the importance of nutrition education it is now time to understand how to impart it.

The nutrition education efforts implemented during the 1970s and early 1980s has brought tremendous changes in nutrition-related behavior or nutritional status. In some areas, the reach may be less which can be attributed to the ineffective communication methods used and the inappropriate content of the messages, which often ignored the specific cultural context of the community.

The conventional strategies for nutrition education focused on one-way transfer of nutrition messages like medical treatment, for curing a nutrition problem, in which the content of nutrition education was dictated. Common examples of this approach are telling mothers to eat more green vegetables or to breastfeed their children and teaching the five food groups in health clinics.

Hence, in contrast to the conventional approach, along with imparting nutritional knowledge, the individuals or groups in the community are encouraged to work in a systematic manner that will stimulate their participation and commitment to the learning process is inculcated in the current approach. Nutrition education undertaken in this spirit is interactive, encourages an exchange of information between the educator and the community and empowers people to make appropriate choices using both scientific and local knowledge. This also provides an opportunity for the educator to understand the needs and wants of the community. It also leads to the adoption of improved behaviour and contributes to lasting effects and changes in nutritional status.

The nature of nutrition education can be attributed to either individual or group method and mass media communication. The individual or face to face approach includes personal contact or conversation, home visit or personal letter. The group methods include demonstration, discussion, role plays, field visits. Mass media like television, radios, and newspapers are also used to propagate nutrition education in modern approach. Let us discuss each one in detail:

11.2.2.1 Individual Methods

In this method, the nutrition educator communicates with the people individually, maintaining separate identity of each person. This method is followed, when the number of people are few, when the subjects are located close to the communicator and sufficient time is available for communication. These include what are known as home farm visits. Since each person's problems are different, the personal approach through such visits result in greater understanding. They help in questing first-hand information, developing good will, establishing confidence and stimulating interest. Individual contact method has its own limitations. It consumes more time, money and labour than the other methods. However, this is the best method for establishing rapport with people and to impart nutrition education.

Advantages of individual method include:

- Helps the nutrition educator in building rapport.
- Facilitates gaining first-hand knowledge of home.
- Helps in selecting demonstrator and local leaders.
- Helps in changing attitude of people.
- Useful in teaching complex lesson.
- Facilitates better transfer of technology.
- Enhances effectiveness of group and mass methods.
- Helps to get more feedback information.

But the **limitations** of this method are,

- This method is time consuming and relatively expensive.
- It has low coverage of audience.
- Changes of favoritism or bias towards some person by the educator can be found.

The individual method used in nutrition education programme are personal contact or conversation, home visit and personal letter.

Personal contact/Conversation

In personal conversation, face-to-face contact takes place between the nutrition educator and the target person. This mode is used to impart nutrition education especially in nutrition behavior modification and when there is need for assessment.

Home visit

Home visit is a direct, face-to-face contact by the nutrition educator with the home makers at their home for nutrition education.

The **objectives** of methods are

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- To get acquainted and to gain the confidence of home maker.
- To obtain and/ or give first-hand information on matters relating to nutrition.
- To advise and assist in solving specific problem and teach cooking and feeding skills.
- To sustain interest.

Home visit for nutrition and health education are done by village health guide. Mid wives, anganwadi workers, local dais and others.

Personal letter

Personal letter is written by nutrition educator to particular person or home maker in connection with nutritional problem. This should not be regarded as a substitute for personal contact.

Objectives of personal letter are

- To answer the queries relating to problems of family and home.
- To send information or seek co-operation on important nutrition programme activities.

11.2.2.2 Group Method

These are the community used forms of nutrition education and are quite effective. A group can be defined as an aggregate of small number of people in reciprocal communication and interaction around some common interests. In the group method, the nutrition educator communicates with people in groups and not as individual person. The size of group may be small (comprising 15-25 person), medium (consisting 25-50) and large group with the composition of 50-100 persons. The group participation and group opinion formation are also important in this method.

Advantages

- This method enables the nutrition/ health educator to have face-to-face contact with many number of people at a time.
- It enables to reach specific part of target group.
- Facilitates sharing of knowledge and experience and thereby strengthen learning by group members.
- Due to involvement of fewer number of peoples, there are more chances of interactions and feedback.
- Motivates people to accept change due to group influence.
- Less expensive and larger coverage than individual method.
- Have much stimulatory action than mass method.

Limitations

- Due to wide diversity interest of group members may create a difficulty in learning situation.
- Holding meeting by arranging all group members at a time is a problem.

- Vested interest, caste, group and village factions may hinder free interactions, participation and decision making by the group members.
- Skill of the nutrition educators or extension worker is an important factor.

The common group methods used in nutrition education are demonstration, discussion methods, role play or drama, field visit/tour.

Demonstration

Among the communication and educational techniques, 'demonstrations' are the oldest, best and simplest tools for transmitting sophisticated technology in a simple and understandable form. In demonstration, the nutrition education agent teaches the group people how to do many kind of work practically, therefore, demonstration is a process of 'learning by doing'. Demonstration can be imparted through method demonstration or result demonstration.

Method Demonstration: A method demonstration is given before a group of people to show how to carry out an entirely new practice or an old practice in a better way. This is essentially a skill training where emphasis is given on carrying out a task effectively by carrying out a job, which shall improve upon the result. This process involves seeing, hearing, participating and practicing in a group which small stimulate interest and action. The examples of method demonstration are weaning food preparation demonstration, proper cooking methods, proper hand washing or sanitary practices, food preservation method demonstration etc.

The **objectives** of method demonstration include

- To teach skills and stimulate people to action.
- To get rid of in effective or in efficient movement.
- To improve upon the result by doing a job in a better way.
- To build up learner's confidence and satisfaction in a practice.

The following points should be considered in methods demonstration

- Knowing the background of the audience properly.
- The knowledge on available resources.
- Start with simple demonstration to complex one.
- The location and accessibility should be considered.
- Keep working plan ready and keep records, prepare talk, chart photos, and other aids for using frequently.

Result Demonstration: Result demonstration is a method of motivating the people for adaption of a new practice by showing its distinctly superior result. The demonstrations are conducted in the home of selected individuals and are utilized to educate and motivate groups of people in their neighborhood. This is very effective method for transfer of new

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technology or innovation in a community. A result demonstration is a way of showing people the value of an improved practice.

The **objectives** of result demonstration include:

- To show the advantages and applicability of a newly recommended practice in community people's/ group member's own situation.
- To motivate groups of people in a community to adopt a new improved practice by showing results.
- To build up confidence of community group members and nutrition educator.
- To develop innovation leadership.

To be successful in the use of result demonstration the extension worker or the nutrition educator must demonstrate only those practices which he/she thinks are good and which are based on 'felt-need' of the community group.

Discussion method

Discussion method is a method of democratically arriving at certain decisions by a group of people, by taking into consideration the members point of view. Discussion methods aim at collective decision making and in improving individual decision making by using the knowledge and experience of colleagues. The group process enhances people's participation and facilitates programme implementation. The discussion methods may be of following types- Group discussion and panel discussion, symposium, workshop, etc.

Group Discussion: It is a 'two-way' communication, people learn by exchanging their views and experiences, for an effective group discussion, the group should comprise not less than 6, but not more than 12 members. There should be a group leader who initiates the subject, helps the discussion in proper manner, prevents side – conversation, encourages everyone to participate and sum up the discussion to an end. It desirable to have a person to record whatever is discussed. The 'recorder' prepares a report on the issues. The member should observe the following rules:

- Express ideas clearly and concisely.
- Listen to what they say, do not interrupt when others are speaking.
- Make only relevant remarks.
- Accept criticism gracefully.
- Help to reach the conclusion.
- Discussion are successful, if the members know each other before hand since they can discuss freely.
- Avoid one to one interaction, address the whole group.
- Avoid repetition to save time.

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Group discussion is a very useful and effective method in changing health and feeding behavior of people.

Panel Discussion: In a panel discussion, 4 to 8 persons qualified to talk about the topic sit and discuss on a given problem (Topic) in front of the audience. The panel comprises a chairman or moderator and from 4 to 8 speakers. The chairman introduces all panel speakers. There is no specific agenda, no order of speaking and no set of speeches. The chairman has to keep the discussion going and develop the train thought. Exploration of the aspect of subject by panel speakers is followed by the audience to take part by asking questions to the panelists. If the panel members or speakers are unacquainted then they may have a preliminary meeting to prepare the subject material and plan of presentation.

Symposium: A symposium is a series of lecture on a selected topic. Each person or expert presents an aspect of the subject briefly. There is no discussion among the symposium members. In the end, the audience may raise questions. The chairman makes a comprehensive summary at the end of entire session.

Workshop: The workshop is the name given to a novel experiment in education. It consist of a series of meeting, usually 4 or more with emphasis on individual work, with the help of consultants and resource personnel. Workshop is divided into small groups and each group will choose a chairman and recorder. Learning takes place in a friendly, happy and democratic atmosphere under expert guidance.

Role Play or Drama: Here two or more persons from the group or given individual, act out a situation followed by a discussion. Audience may enjoy themselves and learn at the same time.

Field Visit or Tour

In field visit or study tour, a group of interested persons accompanied and guided by one or more nutrition educator/expert agents, move out of the neighborhood to study and learn significant improvements. The main purpose is to motivate the visitors by showing what others have been able to achieve. The programme may include visit to anganwadicentre, MCH centre, health centre, community field or villager's place as well as research station and may be held within the district, outside district or even outside the state. The field visit may be synchronized with programmes of national importance like nutrition fair, health fair etc. A group of 30 to 50 persons may be convenient for study tour.

The **objectives** of field visit or tour are

- To expose the visitors to a new and a different situation which shall help in changing their outlook and extent the mental horizon.
- To understand the gap in technology adaptation.

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- To explore the feasibility of adopting new practices in visitors own situations.
- To include a spirit of competition amongst the participants by showing what others have been able to achieve.

General Meeting

A heterogenous group is collected and certain information is passed on to the group. A large number of people can be reached by this method but proper discussion is not available.

Balwadi Feeding Programme

These can be effectively used for educating both mother and child about good nutrition. Good food habits when inculcated in the childhood influences them all their life. Teaching balanced nutrition to the mother is to make her prepare the supplement by herself and feed the child.

School Feeding Programmes and School Gardens

Teaching nutrition in the school years will leave significant mark on the minds of the children. Children can be educated and helped to grow the nutritious vegetable and fruits in their garden so that along with nutrition education it improves their health status also.

11.2.2.3 Mass Methods

In the mass methods, the nutrition or health educator communicates with a vast and heterogeneous mass of people, without taking into consideration the individual or group identity. Therefore the normal boundaries among groups become obliterated. Mass method is followed where a large and widely dispersed audience is to be addressed by the communicator within a short time. The size of the audience may be few hundred in mass meeting; few thousand in campaign and exhibition; and million in newspaper, radio, and television.

Advantages

- Suitable for creating general awareness amongst the people.
- Helps in transferring knowledge and forming and changing opinions.
- Wide range of audience coverage.
- Facilitates quick communication in times of emergency.
- Reinforces previous learning.
- This expensive due to more coverage.

Limitations

- This is less intensive method.
- Little scope for face-to-face contact with the audience.
- Little changes for interaction with and amongst the audience.
- Generalized recommendations hinder application by individuals.
- Little control over the responses of the audience.

- Difficulty in getting feedback information and evaluation of results.

Mass methods which are commonly used to impart nutrition education are discussed below:

Film: Films are used for people who will not attend any kind of meeting. The film should be: simple, direct, interesting, timely and personal. The moving picture should not be used alone. It should be used in connection with a programme or campaign. It should be supplemented with literature, posters, demonstration and discussion. It should lead to action. Good films are used:

- To arouse interest and change attitude.
- To present facts in an interesting way.
- To bring new practices to a village in a short time.
- To reach illiterate as well as literate people.

A film has the following advantages

- A complete process can be shown in a time.
- People identify themselves with those in the picture.

Slides: Slides can be viewed through film strip projection. Slides are used by arranging slides in order that will tell a story of achievements in the villages. A 35mm camera is necessary for making slides and film. The slides are single picture usually in colour. Slides are used in a cardboard frame.

Radio: Radio is a good communication or information media to the community people especially in a country like India and can reach large numbers of people at any given time, even in remote places. Radio is a mass-communication method that can inform, stimulate curiosity, arouse and build interest, create the desire to learn, see, hear and act, widen horizon and mental outlook, breakdown prejudice, and bring enlightenment, promote favorable attitudes and influence emotions, interpret policies, guide listener's interest and helps them grasp the significant new ideas and thought. It carries news bulletins, stories, warnings regarding outbreak of diseases, interviews, short talks, plays, documentaries, question and answer sessions, and special programmes for rural people, urban slum people, housewives and children to disseminate knowledge related to health, nutrition, good living etc. by eminent scientist and nutrition experts, doctors in their respective fields. Availability of low cost transistors sets help radio to penetrate deep into the rural life.

Advantages

- The radio can reach more people more quickly than means of communication.
- It can disseminate timely and urgent information.
- It is relatively cheap.

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- Radio talk can reach illiterate person.
- It builds enthusiasm and maintains interest.

Disadvantages

- The broadcasting facilities are available only in limited place.
- Time assigned to education is limited.
- Frequently losses out in competition with entertainment.
- Difficult to check on results.
- Requires a special technique.
- Not enough sets in rural areas.
- Influence is limited to people who can listen intelligently.
- Generalized recommendations limit their applicability.

Television: Television is an electronic audio-visual medium which provides pictures with synchronized sound. This medium is cosmopolite in approach and can be used to create instant mass awareness. Television combines the immediacy of radio with a mobility of cinema and can carry messages over long distance at a relatively low unit cost. It is a multimedia equipment as it can include motion picture, recording, slide, photograph, drawing, posters, etc. Television can show recorded as well as live programmes.

Advantages of television as a media of health and nutrition education:

- In comparison to motion picture, television can create more impact due to its flexibility, less time taken to record and telecast programmes and wider coverage.
- This is the most suitable method for creating awareness regarding any health issue amongst the mass.
- Helps in transferring, forming, changing opinion.
- Large number of people can be communicated within a short time.
- Facilitates quick communication in times of emergencies.
- Repeat telecast reinforces the points to be considered for the common masses.
- People accept views easily if they are given in the form of entertainment unconsciously or unknowingly.
- Especially Doordarshan imparts knowledge regarding personal hygiene and cleanliness to the children by means of children programme as a result they can get these qualities amidst getting entertained.
- The daily cookery show, women's health and nutrition well-being programmes etc. have set up a new trend in imparting nutrition and health education.
- Awareness on family planning has reached millions because of television.
- It is the commonest, simplest and more effective means of imparting nutrition and health education to the common mass.

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Limitations:

- Requires lots of planning, preparation, trained personnel and availability of equipments.
- Audience participation depends on costly receiving set and availability of electricity.
- Seldom goes beyond creating general as are news of the audience.

Newspaper: Newspaper is a bunch of loose printed folded, which contains news, views, advertisement etc., and is offered for sale at regular intervals, particularly daily or weekly. Most of the newspapers carry a special edition at least once a week, on health related topics. The writings should be:

- Easy to comprehend
- In the local language of the community people.
- Accurate in all details.
- Must be written in short sentences and paragraphs.

Advantages

Newspapers support nutrition education by publishing news of nutrition and health activities and achievements at community levels, education recommendation and packages of improved practices. Success stories, market news, focusing community, advertisement issued by field organization. Input dealers etc. Newspaper can be a good medium of communication in time of crisis and urgent situation.

Limitations: Only literate people generally can take advantage of this medium.

Printed Materials: Literature is the basis of any teaching programme, various types of printed materials such as leaflets, folder, bulletin, newsletter, journal, pamphlets are valuable and essential tools can be used to impart nutrition and health education. These can be used singly or in combination with other education methods.

Exhibition /Melas: An exhibition is a systematic display of models, specimens, charts, photograph, pictures, information etc. in a sequence around a theme to create awareness and interest in the community. This method is suitable for reaching all types of people. The exhibition is better reached if it limits to one theme, simple, timely, large, attractive, durable, well labelled and displayed with large, bold, bright letters, figures and fonts. Posters, Charts, Specimens, Models and Paintings are widely used in exhibitions to arouse interest.

Recorded talks: The tape recorder is an audio aid or instrumental device by which recorded talk on nutrition or health related topics can be played again and again when required. Beside these some traditional

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methods that can be used to impart nutrition education are folk music and dance, and puppet shows

Advertisements: This is a social marketing approach to public health. The latest trend in nutrition education is to use advertising techniques to sell nutrition to the masses. If information is disseminated in terms of lessons, people do not accept it easily. But by using social marketing strategies, nutrition messages can be imparted effectively. Advertising through posters, wall paintings, hoardings and films, are effectively used. Both positive approach, where the benefits of eating a particular food and negative approach, where the dangers of not eating the food can be emphasized, in this approach.

Now, in this context, we have studied the nature of education modes to be used to impart nutritional knowledge to the community for which, training the trainers to use these methods is also an important component.

Check Your Progress

3. Discuss the advantages and disadvantages of mass methods.

4. Write a short note on radio as a medium of communication.

11.3 TRAINING WORKERS IN NUTRITION EDUCATION AND EXTENSION WORK - WHEN TO TEACH, WHOM TO TEACH, WHO IS TO TEACH

We have understood that the key method used to impart nutrition education are communication media and educational methods which enhance the effectiveness of nutrition education process. A main challenge for operative nutrition education is assuring the technical capability of the people who are involved at different stages of education process, including personnel with requisite knowledge and skills in nutrition education and the personnel responsible for facilitating learning by families and communities, program managers, supervisors, project or program designers, technical specialists, technical assistance, those leading monitoring and evaluation activities.

As, a preliminary step to start with the education process, the nutrition educators, who can create a definite impact on the thinking of people, namely, health workers coming into direct contact with the people, the professional and auxiliary health personnel like nurses, midwives, anganwadi workers, physician and practitioners of traditional medicine, who are called as agents of change must be trained, for which an effective training strategy should be devised, develop training guidelines and formulate a training plan for developing the following skills:

- Applied research skills.
 - Communication skills, including the ability to translate technical data into lay language to do community education, carry out

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advocacy at administrative and policy levels, train others, work in a multidisciplinary/multisectoral team

- Knowledge of programme design, management and administration, including planning, monitoring and evaluation, and the ability to write proposals.
- A basic and thorough understanding of human nutrition and the nutritional aspects of food, nutrition and food policies and programmes (e.g. cases of success and failure, selecting interventions from a range of policy options).
- Social science concepts, particularly household economics and behavioral science.
- Fieldwork experience, internships and practice. Also, classroom learning must be complemented by field application.
- The trainers should also be acquainted with the principles of adult learning. The trainers also require training in communication and behavior oriented techniques, and particularly the need for skills in project management is emphasized and nutrition educators must learn all aspects of the training cycle: the needs assessment of the audience and the endeavor, developing clear, measurable goals and objectives consistent with the desired approach, strategies for implementation and development of the training curriculum and teaching methodologies, and delivering and evaluating the training.

11.3.1 Training Strategy

The purpose of training strategy is to define the overall content of training, including who should be trained, what they should be trained in and when the training should take place etc. The training strategy should also establish details about the numbers to be trained, schedules and materials and training of trainers. The training strategy should also establish a link between those who design the messages, products and communication materials and those who design and conduct training and those who implement the education process to ensure that all groups promote the same messages. Thus, in many such aspects the training strategy is the most important part of training process, since all the future training decisions will be made based on the overall context of the strategy.

To implement the strategy, certain guidelines should be developed for the trainers before training.

11.3.2 Training Guidelines

The training guidelines are designed to train a nutrition educator to improve nutritional status in his/her area. The following points should be considered while planning the training:

- Studying the socioeconomic factors, religious beliefs, customs and traditions affecting the dietary patterns as education must be individualised to the group.

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- Development of nutrition education material in local languages and local prevalent problems so that the goal of education i.e. improvement of health status is attained.
 - Supplementary feeding programmes relating to the mother and child welfare can be planned and implemented.
 - Simultaneous teaching of school children the facts about good nutrition and, similar work with parents through extension services, health services and adult groups is also needed to attain success.
 - Also, the nature of nutrition education programmes should include means to develop nutrition advisory services for the public.
 - The trainers should be trained a coordinated approach in community nutrition programmes and the target group should also be involved in developing supplementary nutrition programme where ever necessary.
 - Education in nutrition is probably most effective, when the trainers choose a place for training, similar to that where it will be applied. For example, teaching people to improve family food practices is most practical and convincing when done in an ideal home of a nearby community centre.
 - Centers to which individuals go for health services are natural settings for education in nutrition e.g. MCH centers.
- With these guidelines in mind, a proper training plan should be developed that can facilitate the learning process.

11.3.3 Plan for Training Programme

All trainers should first learn the basic principles of training which includes how to conduct needs assessment, formulate a curriculum, and select the appropriate teaching method and lesson plan. The different steps involved in formulating a training plan are:

- 1. Assessing the Learning Needs:** This is the first and crucial step in planning a training. Collect the baseline information regarding nutrition problem in a community by nutritional survey, observation, questionnaires, individual and group meetings and by compiling the results to know the correct prevalent problem which needs the education especially pertaining to the vulnerable or target group like infants, preschoolers, pregnant and lactating mothers and geriatrics. Thus assessing the needs will help us to know:
 - What the learner in the community requires?
 - What are the existing competencies, skills, knowledge already available with the learner?
 - What is the expectation of the learner from the nutrition education programme?
- 2. Defining Training Objectives:** The trainer must specify and define the training objectives clearly. The needs assessment helps us to identify the objectives for training. These objectives will direct the entire plan for training programme and affect the selection of content areas and teaching methods.
- 3. Deciding on Content Area:** Content areas are absorbed from the objectives. The content areas will include actual topics and subject

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matter, on which the learners want to gain knowledge, skills and awareness.

4. **Arranging Contents:** A lesson plan, has to be designed in which the contents are arranged in a logical way, that forms linkages from one content to another without disrupting the chain of thought and ensuring fast learning by the learners.
5. **Selecting Appropriate Teaching Method:** The trainers must also know “what teaching methods are available, secondly, they should know, “when to use a given method”, and thirdly “should become efficient in using each method”. The educators can choose from any of the three types of methods discussed already, according to the need of audience, types of target group, available resources and feasibility. For example, information about local foods and their relationship to health can be popularised by means of plays or puppet shows, by exhibits of good local diets in public plays and through tales by popular story teller in the villages.
6. **Selection of Appropriate Teaching Aids:** The use of teaching aids by the trainers can help grasp attention from the participants, key points can be emphasised and well remembered, step by step explanation and sequencing of information is effective. Rather than using one way formal lecture method, inclusion of aids along with it, can stimulate understanding, discussion and participatory learning. For instance, Families can be reached through farm radio programmes. The trainers should consider certain points while choosing the aids:
 - **Situation:** To whom will the presentation be made, individuals or groups? Where will the presentation take place –Centers, Clinic, Classroom or field?
 - **Subject Matter and Desired Effect:** What emotion is the educator trying to arouse? Does the information require gradual building up and linking with other information?
 - **Cost:** Certain teaching aids like films, slides, overhead projectors are expensive and the fund allotted to the educator must also be considered before deciding the choice of teaching aids.
7. **Putting the entire Schedule into a Time Frame:** Time frame for each content should be determined, so that the total time period for the entire programme can be planned. With the time frame, appropriate venue, type of approach whether individual or group approach etc. can be determined.
8. **Teaching Skills to the Trainers:** The three main skills that the nutrition educator must be trained are for:
 - Manual skills- Using hands skillfully for nutritional assessment (anthropometrics and survey methods).
 - Thinking skills - Identify children at risk of malnutrition.

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- Communication skills- Ability to convince people to change and adapt to new cooking and eating practices.

Having learnt the training strategy, the guidelines for training and the training plan ready, the trainers are now ready to conduct the nutrition education training to the designated target audience.

11.4 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

1. Nutrition education is a set of planned educational activities targeted at certain population groups and aimed at acquiring healthy nutrition behaviors. (Gil, 2010)

Nutrition education is a process that helps individuals, families, and communities make informed choices about food and lifestyles that support their physiological health, economic, and social well-being.(USDA, 2012b)

2. To create positive attitudes toward good nutrition and physical activity. To provide motivation for improved nutrition and lifestyle practices conducive to promote and maintain the best attainable level of wellness for an individual. To provide adequate knowledge and skills necessary for critical thinking regarding diet and health so the individual can make healthy food choices from an increasingly complex food supply. To assist the individual to identify resources for continuing access to sound food and nutrition information. The need for nutrition education has been strongly reinforced by the concept of the Right to Food. The public requires information and training to recognize their food rights and to learn how to participate in decisions that affect them. To provide information and education on good diet, food safety, food-borne diseases, food labelling and processing, production and preparation; while in the school curriculum integrating agriculture, food safety, environment, nutrition and health education builds citizens' capacity to achieve and maintain their own food security. Hence nutrition education is an essential vehicle for establishing food rights. To educate on good family and complementary feeding through sharing knowledge and skills on how to optimize the use of locally available foods, so that maternal and child feeding practices can be improved. Nutrition education provided at elementary level lays a strong foundation for promoting lifelong healthy eating and improving long- term, sustainable nutrition security. To educate about the use of locally available and seasonal foods, and

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highlighting that optimal nutrition need not be expensive always. For instance, most mothers are not so poor as not to be able to afford 50-100 gmsof green leafy vegetables to child daily, if they realize that this may make a difference between blindness and normal vision. Nutrition education is important to enhance and enrich knowledge and corrects faulty concepts of nutrition. As an example, cooked pulses that are high in protein. But, weaning infants often are not fed dal out of fear that it will produce flatulence and illness. Nutrition education is an essential means to ensure better health practices and food habits through an increase knowledge and favorable attitudes. This includes changes in the breast feeding and weaning practices following diarrhea. To improve the nutritional levels of the community by wise use of the available means that control malnutrition

3. Advantagesof mass methods:

- ✓ Suitable for creating general awareness amongst the people.
- ✓ Helps in transferring knowledge and forming and changing opinions.
- ✓ Wide range of audience coverage.
- ✓ Facilitates quick communication in times of emergency.
- ✓ Reinforces previous learning.
- ✓ This expensive due to more coverage.

Limitations of mass methods:

- ✓ This is less intensive method.
- ✓ Little scope for face-to-face contact with the audience.
- ✓ Little changes for interaction with and amongst the audience.
- ✓ Generalized recommendations hinder application by individuals.
- ✓ Little control over the responses of the audience.
- ✓ Difficulty in getting feedback information and evaluation of results.

4. Radio: Radio is a good communication or information media to the community people especially in a country like India and can reach large numbers of people at any given time, even in remote places. Radio is a mass-communication method that can inform, stimulate curiosity, arouse and build interest, create the desire to learn, see, hear and act, widen horizon and mental outlook, breakdown prejudice, and bring enlightenment, promote favorable attitudes and influence emotions, interpret policies, guide listener's interest and helps them grasp the significant new ideas and thought. It carries news bulletins, stories, warnings regarding outbreak of diseases, interviews, short talks, plays, documentaries, question and answer sessions, and special programmes for rural people, urban slum people, housewives and children to disseminate knowledge related to health, nutrition, good living etc. by eminent scientist

and nutrition experts, doctors in their respective fields. Availability of low cost transistors sets help radio to penetrate deep into the rural life.

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11.5 SUMMARY

To sum up, this unit has taught us that, Nutrition education is the process of teaching the science of nutrition to an individual or group. The major focus of this type of nutrition education is not knowledge and facts, but rather the development of permanent behavioral changes that improve the nutritional status of the community. Also, educating the masses is not an easy task and the educators must be trained systematically and develop the skills of both teaching and learning process.

11.6 KEY WORDS

- **Nutrition Education:** Educating the science of nutrition.
- **Nature of Nutrition Education:** Methods of nutrition education.
- **Conventional Approaches:** Traditional methods.

11.7 SELF ASSESSMENT QUESTIONS

Short Answer Questions

1. Write a short note on television as a medium of nutrition education.
2. Explain the individual approaches to educate the community.
3. Give any two definitions of nutrition education.

Long Answer Questions

1. Explain the mass methods of nutrition education.
2. Discuss the steps in planning for a training programme.
3. Elaborate on how to train the trainers.

11.8 FURTHER READINGS

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BLOCK-IV: NUTRITION EDUCATION PROGRAMMES, FOOD PRODUCTION AND FOOD SPOILAGE

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UNIT -12 PRINCIPLES OF PLANNING, EXECUTING AND EVALUATING NUTRITION EDUCATION PROGRAMMES

Structure

- 12.0 Introduction
- 12.1 Objectives
- 12.2 Principles of Planning Nutrition Education
- 12.3 Executing the Nutrition Education Programme
- 12.4 Evaluation of Nutrition Education Programme
- 12.5 Problems of Nutrition Education Programme
- 12.6 Answers to Check Your Progress Questions
- 12.7 Summary
- 12.8 Key Words
- 12.9 Self-Assessment Questions
- 12.10 Further Readings

12.0 INTRODUCTION

Nutrition education is a mechanism to enhance awareness, as a means to self- efficacy, surrounding the trigger of healthy behaviors. Nutrition education should be practical and should be easily adoptable to the socioeconomic status, food habits and the available local food resource generally needed for the purpose of demonstration and feeding of the locally available audience. Nutrition education programme should become a part of the community. Such, programmes well organized by trained educators will be wise and efficient to bring out a change in the community. In this unit, we shall discuss about planning, executing and evaluation of nutrition education programmes.

12.1 OBJECTIVES

After studying this unit, you will be able to:

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- Explain the principles of planning a nutrition education programme.
- Discuss how to execute the nutrition education programme.
- Understand the means of evaluating the nutrition education programme.
- We have already in unit 10 discussed on planning a training programme for training the trainers. Now, let us discuss the systematic way of planning of nutrition education programme for the community, which also correlates with the previous one.

12.2 PRINCIPLES OF PLANNING NUTRITION EDUCATION

Planning is the fundamental management function, which involves deciding beforehand, what is to be done, when is it to be done, how it is to be done. Planning a nutrition education programme can be divided into two phases viz. Conceptualization phase and Formulation phase.

Conceptualization phase: This phase involves defining the nutritional problems and determining the causes of problems which is done by causal analysis. For conducting causal analysis specific to a community, formative research is conducted that describes investigations conducted for programme design and planning.

Formulation Phase: Here, the objectives of nutrition education are set, designing messages are carried out, in short the elements conceptualized in the previous phase are given shape and structure.

The steps involved in planning a nutrition education programme are:

1. Identification of Target Audience: Target audience are the group of people with whom the trainer communicates for change in behavior. The target audience can be classified into three segments as Primary, Secondary and Tertiary audience.

Primary Target Audience: These are the individuals who would actually change their nutrition and health practices. For example, mothers of young children, pregnant and nursing mothers who would modify their dietary behaviour.

Secondary Target Audience: These are the people who can be motivated to teach, support and reinforces the practices and beliefs of the primary audience. Health care providers, public figures and family and friends fall into this category.

Tertiary Target Audience: Individuals who are decision makers, financial supporters and other influential people like school teachers who facilitate the communication process and behavior change and make the programme a success fall into this group.

Thus, the nutrition education planners must determine the type of audience and clearly spell out the specific audiences targeted and the objectives during the programme.

- 2. Identification of the Problem to be Addressed:** The next step is to analyse the needs of the target audience and the problems to be addressed. The identification of the problem can be done by considering the following criterias:
- Age and gender distribution of the community population of interest.
 - Rates of morbidity and mortality in that area.
 - Prevalence of common illnesses and their causes.
 - The most at-risk target group that require nutrition education.
 - Health care facilities that are available.
 - Identification of the health workers or trainers who promote nutrition education.
- 3. Assessment of Resources:** The next step for the nutrition educator while planning is to assess the valuable resources like money, time, human resources, facilities required to carry out the programme.
- 4. Establishment of Educational Objectives:** In nutrition education we aim to change people's behavior, in ways that will improve their health. Change of knowledge or even of attitude, which does not lead to change of behavior will not achieve the goal. Social scientists have evolved many models to explain the process of change within individuals. Therefore, to understand the process of adoption it will be relevant to see the Cart-wright's theory.

Cart wright's Theory: According to Cart-wright we have to change three structures in a person's mind in order to change their behavior, namely, cognitive structure (knowledge, information), motivational structure (attitude & beliefs), action structure (practices), which are similar to the three parts of a Knowledge, Attitude and Practice (KAP) survey. Before carrying out any nutrition education, it is important to know the existing knowledge, attitude and practices (KAP) of the community concerned. Nutrition education is a two way process, and we must learn from those we hope to teach. Without understanding their present position, it will be difficult to influence them. We should start from where they are, and understand their culture. Culture is the habits and customs of a group of people. For example, take up the supplementary feeding programme for under-nourished children along with growth monitoring programme. The behavior required is that the mother should bring the child to the centre on fixed days and times for certain periods.

Stage 1: Cognitive structure, knowledge (K): The minimum information required by the mother is as follows:

1. Malnutrition/retarded growth can be prevented.
2. Role of hygiene in avoiding infections, so as to break the cycle of disease and malnutrition.

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3. Time of introduction of semi-solids (age of weaning).
4. How and what to give during weaning?
5. Importance of supplementary diet distributed in the centre.
6. Place and time for weighing the child.
7. Importance of maintaining growth chart.

It is not effective to give much unnecessary information which will not be assimilated and retained by most people. If too much is given, the essential things may not be remembered. Even giving information is not as simple as many people think. For example, in nutrition education, first people have to be convinced that prevention is a possibility.

Stage 2: Motivation, Attitude (A): Motivation is the force that makes people want to do something. It is related to people's goals and aims. However, motivation should be intrinsic based on the internal and practical needs of local community. For supplementary feeding/growth monitoring programme, the motivation of the mother may be through, other mothers or mahilamandals, Panchayat meeting etc.

Stage 3: Action, Practice (P): Even though the mother may have the required information and motivation, she may not take the action due to hesitation or certain inhibitions in her mind. If the time and place for supplementary feeding is not convenient, she may have to miss a day's work, each time, and if she is poor that may not be possible or the elders at home may not like the idea of weighing the child.

Hence, framing of educational objectives must be based on these aspects of curriculum.

- 5. Development of a Detailed Plan of Action:** The final step is to develop a detailed plan of action, by comprehending the following statements:
- List of culture and food habits of the people and what foods are available.
 - Spontaneous change in food habits is not possible for any one. Gradual changes with implementing one new idea and change at a time would be recommendable and should also be interrelated with current practices. Hence, devise one change at a time.
 - Make the community become aware of what is the need to discuss about nutrition and its importance and what kind of foods promote balanced health.
 - To ensure good communication use local words and language.
 - While teaching, use original foods produced by home gardening to motivate the community to do the same.
 - Use appropriate teaching aids wherever possible.
 - Always encourage questions and give satisfactory answers to clear doubts.

- Try to link the teaching on nutrition with MCH activities or other health education methods, may be with ICDS or anganwadiprogrammes.
- Do not teach people that are not possible for them. For example talking about expensive or unavailable foods.
- Follow up and find out the changes in food practices. Solve the practical difficulties that the target people face.

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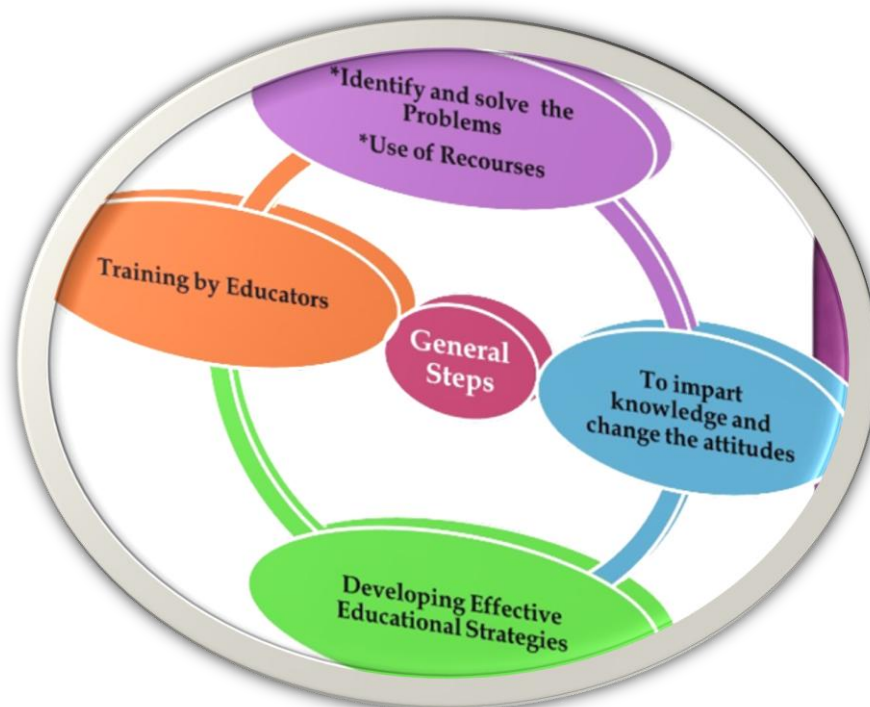


Figure 12.1 General Steps in Planning a Nutrition Education Programme

6. Production of Communication Materials: The materials which are used to transmit messages are called as communication materials. The aspects to be well-thought-out in making communication materials during the planning phase are as follows

- The total amount of communication material that need to be produced.
- Selecting people who will be able to produce the materials.
- Communicator of different types who will produce the materials.
- Communicator of different types who will use the materials.
- Process of distributing the materials.
- The different methods of use of these materials.
- The complete cost required for the above mentioned activities.

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Thus, all these steps require a multidisciplinary team to develop these materials, pretesting of the materials and large scale production of these materials after which the education programme is ready to be implemented. Let us study each one of these now.

a. Need for Multidisciplinary Team: The development of communication materials need a team of people from different disciplines to work together and put in their effort and knowledge. For example, a nutritionist formulates message content, creative or graphic artists designs and translates the messages into attractive communication materials, while a technician or an engineer is responsible for giving life to the messages and communication materials with the effect of lights and sounds, and an overall coordinator coordinates the work of nutritionist, artist and technician for a constructive outcome of the communication material.

b. Pretesting Communication Materials: Pretesting is an activity conducted to measure the impact of communication material prior to implementation, on a representative sample of the intended audience. This pretesting helps the nutrition educator to find out whether the representatives like the materials, they can interpret the illustrations, messages and visuals correctly, portrayal of message has relevance to their needs and objectives, and there is any embarrassment for any group of people. Accordingly, the success of the communication material and program can be determined by pretesting itself and this also provides an opportunity for the corrections required if any before actual implementation.

c. Large Scale Production of the Communication Materials: Once the draft model of the materials have been finalised a large scale production can be thought of and certain factors like material cost, development cost, pretesting cost, dissemination cost and overall administration cost should be considered.

The next step after the development of required communication materials like audio cassettes, film script, funnel graph, live programme, presentation, rehearsals and videos etc. is to design and implement the training schedule.

Check Your Progress

1. What is conceptualization phase?
2. Write a short note on cart-wright theory.

12.3 EXECUTING THE NUTRITION EDUCATION PROGRAMME

After training and planning, the well trained efficient nutrition educators of the multidisciplinary team execute communication activities to the target audience through messages and teaching materials or tools. Execution or implementation of nutrition education programme, i.e. carrying out the activities in the field, is the vital part of imparting nutrition education. The first step in execution is considering our target population about whom we have discussed already. However, not all the members of the same target group react in the same way to the nutrition and health messages taught by

the trainers. While execution, situation may arise where the developed plan has to be modified and special efforts are required, according to the understanding levels of the target audience. A few members of the group called innovators, may begin the new practices immediately after promotion by the nutrition education programme. Some people known as early adopters, may follow the footsteps of the innovators and adopt practice as well, while slow adopters are the group of audience who have a favourable attitude towards the nutrition education programme, but hesitate to adopt the change. Certain people may be indifferent and resist change who need a persuasive tackling.

Different teaching materials or tools will be used by the efficient and well trained educators of the multidisciplinary team to execute nutrition intervention to the target audience. The education is delivered either through individual, group or mass approach to the audience. The different modes of nutrition education according to the approaches has been discussed in detail under nature of nutrition education of unit XI.

The two important key factors for successful implementation of the programme is through community participation and social marketing. We can study each one in detail.

Community Participation: Community means more than just people who live together, it implies sharing and working together in some way. In other words, a community is referred to as stable, small, autonomous and self-contained unit such as colonies, tribes, villages and immigrant areas. Community has also been used for towns and cities which has common interest, common pattern of socio economic relations, similar occupations, common bond of solidarity, network of social institutions and some degree of group control. Community members may have certain problems which they want to solve together for which they come in groups. This introduces us to the term community participation. Community participation means adopting a 'bottom-up' approach where members of the community make decision rather than 'top-down' approach where the decisions are made by senior persons in health services- the so called 'experts'. Participation by a community may vary in degree depending upon the extent of their participation. We will now discuss various aspects of community participation like spectrum of community participation, types of community groups, the process and benefits of community participation.

a.Spectrum of Community Participation: An important reason for community participation is a need to shift the emphasis from the individual to the community. Many influences on behaviour are at the community level and not under the individuals. This includes social pressure from other people, norms, culture and the local socio-economic conditions. There is a continuum of participation, where at one extreme the actions are forms of manipulation. Manipulation means the decisions are taken by the outsiders and the community is like a puppet pretending to be decision makers. The other form is consultation in which the opinion the community

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is sort but the decision is left to outsiders and at the other extreme it is community control, in which complete power to make decisions is given to the community which ensures total community participation. All these spectrums play a major role while implementing nutrition education in the community.

b.Types of Community Groups: Community groups help community members agree on common problems and recognise that they can solve problems by themselves with the help of nutrition educators. There are different types of community groups which can be formed in a community.

They are:

- Self-help groups- Run by people for their own benefits.
- Representative groups- Elected and answerable to the community.
- Pressure groups- A group of self-appointed citizens taking action on what they see to be the interest of the whole community.
- Welfare groups- Exist to improve welfare of others. Eg: Operating feeding program.
- Traditional organisations- Well established groups meeting the needs of a particular section of the community (Parents-Teachers associations, Mothers Union, etc.)

Thus we can identify these groups in the community and seek their support in execution of nutrition education programs. As community participation is a very slow, difficult and gradual process while executing the nutrition educators has to visit the community groups, establish a rapport with them and initiate communication to invite their participation.

a. Process of Community Participation: The technique of carrying out communication regarding nutrition education with the community depends upon the skills of the trainer. For example, health and nutrition may not be the felt need of the community in the beginning but the trainer can make them aware of the needs and importance of change in dietary behaviour gradually.

b. Benefits of Community Participation: Community participation leads to a better relationship between the community and the health workers which have proved a sustained participation by the community in accomplishing the objectives of nutrition education programs during implementation. In addition development of primary health care is also ensured. As community participation helps the members to collectively seek solutions for their problems it gives them a sense of ownership and helps them to pool their resources to solve common nutritional problems.

Thus community participation plays a major role in implementing nutrition education plan.

Social Marketing: Social marketing describes the application of marketing principles to the design and management of social programs that is related to service utilisation, product development and behaviour adoption. An example of social marketing approach to improve child feeding practices is in Indonesia is as follows: "A mother in Indonesia explained to the team of trainers that the reason for not including greens to her child's diet is because greens are difficult for the baby to digest. However after being counselled by her community health worker and doctor on radio she feeds

her child a mixed food with green leaves. So did 85% of the women in this province which significantly improved the nutritional status of 40% of the children under 2 years. In order to know how social marketing can promote positive nutrition and health behaviours are attributed to few purposes and techniques as discussed below:

- The first purpose of social marketing is to bring about a change in behaviour and not just imparting information. Social marketers have an eye on what it will take to get people to try something new, whether it is going to the health centre or cooking green leafy vegetables every day for the children.
- The second purpose of social marketing is to demand creation. The social marketing on one hand promotes awareness on nutritious foods but the demand is not met due to less supply. Hence awareness promotion is also a need for suppliers.
- The technique to understand consumer demand is formative research, which increases the feed forward approach and minimizes feedback shocks. This helps to promote behaviour changes, create demand and shapes the products and fine tune the promotional angle. For example, breast milk can be promoted as the best food for young babies and protective as it has antibodies. However the motivational appeal to mothers may be that it is a convenience food as it does not require any cooking, if convenience is what mothers want.
- Finally social marketing requires creativity to efficiently implement the nutrition education program in the community.

Thus we have learnt that how community participation and social marketing approach help in executing positive health and nutrition behaviours through nutrition education.

After planning and execution, it is the evaluation step that concludes the process of nutrition education programme.

12.4 EVALUATION OF NUTRITION EDUCATION PROGRAMME

Evaluation is an integral part of programme planning of nutrition education and is an important in any process since it helps us to determine the extent of successful implementation of a programme and to assess to what extent the programme has met with the predetermined objectives. Adequacy, effectiveness and efficiency are the components to be measured in any programme implementation. Community participation should be assured in evaluation process. Evaluation helps to make decisions regarding the continuity of the same methods or if any requirement for change of strategy is required for effective implementation of the programme that is, evaluation provides periodic assessments of progress towards objectives in order to make timely adjustments in implementation to assure success. The process of evaluation can be

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classified as process evaluation, summative evaluation and formative evaluation.

Process Evaluation: It is a tool for monitoring progress, in which, the emphasis is on documenting and analysing the way the programme works in practice, to identify and understand influences on its operation and achievements. It is further indicative of the likelihood of expected outcome, whether the programme is running of the scheduled time frame or not. The important function of process evaluation is to provide information about the congruence between the programme design and implementation. If the nutrition education programme do not meet the required expectations changes or modifications in execution can be exerted.

Summative Evaluation: Summative evaluation is the systematic use of research techniques to measure outcomes and overall programme effectiveness. For example, it is not enough to know what the nutrition education has taught to the community, but the ultimate goal that is required is change in behaviour and improvement in nutritional status as a result of education. In the sense, if the adolescent anaemic girls are the target audience for enriching the haemoglobin levels by intake of iron folic acid supplements, then summative evaluation of this programme includes, examining the proportion of adolescent girls who started consuming tablets after the implementation of education programme, accessibility to supplements and complications of side effects. Thus, a useful summative evaluation looks at the process of intervention's effects as well as measuring its overall impact.

Formative Evaluation: Formative evaluation involves gathering information at the early stages of implementation with the focus on finding out whether the efforts are executed as planned, without any barriers or obstacles, and if any identified, feasibility of midcourse corrections and adjustments can be sorted to ensure success of the nutrition education programme. Essentially, formative evaluation is a structured way to provide the trainer an additional feedback about their work, which helps to improvement in the implementation process, if any required.

Having understood the needs and types of evaluation, we shall look into how to carry out the evaluation process.

Conducting the Evaluation

An evaluation should ensure participation of all those who were involved in the nutrition education programme, viz. the target audience, the trainers and the programme planners. The tools that are proposed to carry out the evaluation process are causal analysis, hippopoc table and dynamic model.

- **Causal Analysis:** Causal analysis of nutrition education programme consists of creating an intersectoral setting and network of factors which affect the nutritional status of population. It helps to select an appropriate intervention, develop communication between intersectoral

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teams and for evaluating the relevance of intervention. Causal analysis also, allows to identify confounding factors which can influence success and failure of the intervention.

- **Hippopoc Table:** After the completion of causal analysis, a hippopoc table is constituted, in which the inputs, procedures outputs and outcomes of nutrition education programme are organized in form of a table, to seek answers to the following questions :
 - Has the nutritional problem to be solved been clearly carried out?
 - Has the causal analysis been carried out?
 - Has the formative research to understand the behaviours and the channels of communication of the target population been carried out?
 - Had the objectives been clearly defined in terms of modification of the nutrition related behaviours and in terms of acquisition of knowledge, attitude and skill development?
 - Had the communication materials developed conveyed messages clearly?
 - Were the trainers trained for the carrying out effective education process and the use of aids?
 - Were the activities carried out in accordance with the plan?
 - Did the outcome of analysis matched with the objective at the end of the programme to determine success?

The answers to these questions helps to evaluate what had been done and how it had been done.

- **Dynamic Model:** Here, the relationship between the inputs, process and outcome are represented in the graphic form. The graph helps to determine the success, failures and to plan for improvement of a nutrition education programme.

Thus, evaluation is not simply an activity external to the intervention, rather, a crucial component of nutrition education.

Contribution of Nutrition Education Programme to Changes in Behaviour

Through the evaluation methods, we can determine whether the expected change in target audience has been achieved or not. However, the contributory factors for the change can be examined by the two methods of analysis: control group method and indirect method without using control groups for comparison.

1. **Control group method:** In this method, two groups are set. Both the groups should contain the same sample size of similarities in age, education and income. The difference lies in that, one group known as

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the test group receives nutrition education, while the other group known as the control group does not receive any nutrition education. After the education programme is over for the test group, both the groups are subjected to analysis to assess the change before and after intervention. If the test group performs better than the control group, and shows a positive change in the behaviour after the education programme then this determines the success of nutrition education.

2. Indirect method: In situations where it is not possible to set a control group, indirect method can be used. The target audience are interviewed or surveyed before nutrition education, to observe their dietary patterns and food habits. The same group is assessed for the same criteria after the nutrition education period to find out the impact of nutrition education, any positive changes observed can be attributed exclusively to the process of nutrition education.

With this knowledge of evaluation, an effective evaluation system can be developed according to the demands of the nutrition education programme executed. In nut shell,

- Integrate evaluation in the programme from planning phase itself.
 - Allocate adequate time to nutrition education programmes, with the time frame for evaluation also clearly defined.
 - Clarify the purpose of evaluation. Prepare a realistic, achievable and measurable indicators for success.
 - Always control group is preferred, if not possible collect data accordingly, to establish that the change in behaviour is achieved because of the efforts of nutrition education programme executed.
 - Multiple methods of data collection and analysis is ideal to ensure validity of the findings.
 - While evaluating, extraneous control factors and bias should be eliminated.
 - Look out for any unplanned benefits or unexpected problems.
- With this briefings, now it is clear that evaluation need not carried only at the end of the intervention, even in between evaluation process is possible so that the time, man power and financial resources are saved. Also, if the evaluation is considered as a part of every phase, then failures can very well be minimized. This will also give more credibility to nutrition education practice and the programme would not be seen with doubt.

The abstract of this unit, is depicted in the figure, mentioning each of the phases namely, planning, execution or implementation and evaluation clearly.

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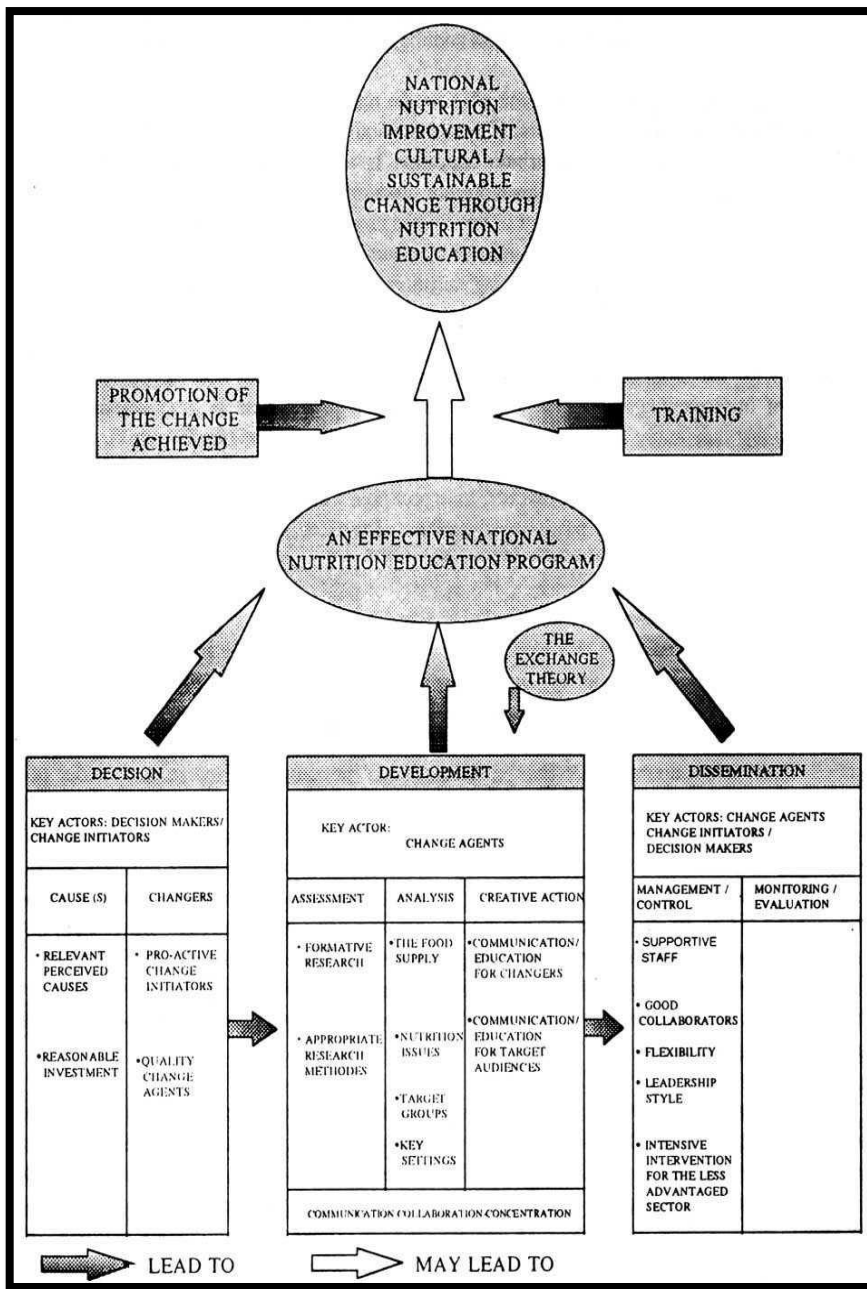


Figure 12.2: A Conceptual Framework of Nutrition Education Programme

Check Your Progress

- 3. What are the types of community groups?
- 4. What is control group method in evaluation?

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12.5 PROBLEMS OF NUTRITION EDUCATION PROGRAMME

The nutrition education programmes, however planned with proper objectives, training and execution, it may prove ineffective if the targeted population does not apply the education in their day to day activities. The problems of nutrition education programmes are listed below:

- The nutrition education is not fruitful unless the economy and per capita expenditure capacity of the targeted population is increased. For example, most of the nutritional deficiencies are because of under nutrition and increase in energy and protein consumption is favored by foods of high calories and proteins, and foods of high biological value which are ultimately expensive.
- Through nutrition education programmes to completely change the behavior or the psychological patterns of cooking and eating may not be possible. For example, we may teach the targeted audience that traditional Indian method of cooking rice, may leach out B vitamins, but the community may not accept the practice of pressure cooking for varied reasons like inhibition and fear in the use of technology of handling pressure cookers, lack of money to buy cookers, inability to accept the difference in taste of rice etc.
- Cultural influences may provide a setback for nutrition education programmes. To make the mothers feed children with greens, to start weaning foods at an earlier age, to convince that fruits do not induce cold and fever are some zones where nutrition education fails at times.
- To reach the masses will be time consuming, and an immediate effect of nutritional education programme on the nutritional status of the community cannot be anticipated.
- Also, whatever has been taught or educated to be used by the community in nutrition education programmes, if not available for use or supply is not met, then the purpose of nutrition education programme is not served.

12.6 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

1. Conceptualization phase: This phase involves defining the nutritional problems and determining the causes of problems which is done by causal analysis. For conducting causal analysis specific to a community, formative research is conducted that describes investigations conducted for programme design and planning.

2. Cart wright's Theory: According to Cart wright we have to change three structures in a person's mind in order to change their behavior, namely, cognitive structure (knowledge, information), motivational structure (attitude & beliefs), action structure (practices), which are similar to the three parts of a Knowledge, Attitude and Practice (KAP) survey. Before carrying out any nutrition education, it is important to know the

existing knowledge, attitude and practices (KAP) of the community concerned. Nutrition education is a two way process, and we must learn from those we hope to teach. Without understanding their present position, it will be difficult to influence them. We should start from where they are, and understand their culture. Culture is the habits and customs of a group of people.

For example, take up the supplementary feeding programme for under-nourished children along with growth monitoring programme. The behavior required is that the mother should bring the child to the centre on fixed days and times for certain periods.

Stage 1: Cognitive structure, knowledge (K): The minimum information required by the mother is as follows:

1. Malnutrition/retarded growth can be prevented.
2. Role of hygiene in avoiding infections, so as to break the cycle of disease and malnutrition.
3. Time of introduction of semi-solids (age of weaning).
4. How and what to give during weaning?
5. Importance of supplementary diet distributed in the centre.
6. Place and time for weighing the child.
7. Importance of maintaining growth chart.

It is not effective to give much unnecessary information which will not be assimilated and retained by most people. If too much is given, the essential things may not be remembered. Even giving information is not as simple as many people think. For example, in nutrition education, first people have to be convinced that prevention is a possibility.

Stage 2: Motivation, Attitude (A): Motivation is the force that makes people want to do something. It is related to people's goals and aims. However, motivation should be intrinsic based on the internal and practical needs of local community.

For supplementary feeding/growth monitoring programme, the motivation of the mother may be through, other mothers or mahilamandals, Panchayat meeting etc.

Stage 3: Action, Practice (P): Even though the mother may have the required information and motivation, she may not take the action due to hesitation or certain inhibitions in her mind. If the time and place for supplementary feeding is not convenient, she may have to miss a day's work, each time, and if she is poor that may not be possible or the elders at home may not like the idea of weighing the child.

Hence, framing of educational objectives must be based on these aspects of community.

3.Types of Community Groups: Community groups help community members agree on common problems and recognise that they can solve problems by themselves with the help of nutrition educators. There are different types of community groups which can be formed in a community. They are:

- Self-help groups- Run by people for their own benefits.

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- Representative groups- Elected and answerable to the community.
- Pressure groups- A group of self-appointed citizens taking action on what they see to be the interest of the whole community.
- Welfare groups- Exist to improve welfare of others. Eg: Operating feeding program.
- Traditional organisations- Well established groups meeting the needs of a particular section of the community (Parents-Teachers associations, Mothers Union, etc.)

4. Control group method: In this method, two groups are set. Both the groups should contain the same sample size of similarities in age, education and income. The difference lies in that, one group known as the test group receives nutrition education, while the other group known as the control group does not receive any nutrition education. After the education programme is over for the test group, both the groups are subjected to analysis to assess the change before and after intervention. If the test group performs better than the control group, and shows a positive change in the behaviour after the education programme then this determines the success of nutrition education.

12.7 SUMMARY

To conclude, nutrition education must be well planned in all aspects of the training cycle. The main challenge for success of nutrition education lies not only in proper training of the nutrition workers or multisectoral people involved at different levels of program execution, but the participation of the target audience is very vital. Many programs measure indicators of nutritional status only at baseline and again at the end of the program, rather it is well understood that evaluation can be carried at any point of nutrition education programme.

12.8 KEY WORDS

- **Planning:** Planning is the fundamental management function, which involves deciding beforehand, what is to be done, when is it to be done, how it is to be done.
- **Execution:** Carrying out the planned activities in the field in a systematic manner.
- **Evaluation:** Periodic assessment of progress towards objectives

12.9 SELF-ASSESSMENT QUESTIONS

Short Answer Questions

1. Discuss the steps in planning a nutrition education programme.

2. Explain the types of evaluation.
3. Write a short note on community participation.
4. Explain the problems in nutrition education programmes.

Long Answer Questions

1. Elaborate the need for planning and steps in planning a nutrition education programme.
2. Describe the process of implementation and the role of social marketing.
3. Discuss the conceptual framework of nutrition education programme.
4. Explain the procedure of conducting evaluation.

12.10 FURTHER READINGS

- Suryatapas, 2018, Textbook of Community Nutrition, 3rd Edition, Academic Publishers, West Bengal.
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UNIT -13 FOOD PRODUCTION

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Structure

- 13.0 Introduction
- 13.1 Objectives
- 13.2 Objectives of Agriculture Planning
- 13.3 Green Revolution
- 13.4 Blue Revolution
- 13.5 White Revolution
- 13.6 Yellow Revolution
- 13.7 Answers to Check Your Progress Questions
- 13.8 Summary
- 13.9 Key Words
- 13.10 Self-Assessment Questions
- 13.11 Further Readings

13.0 INTRODUCTION

Food production involves the process of growing and harvesting food grains. It is also defined as the process of preparing food by converting raw materials into ready-made food products either in the home or in the food industries. Sustainable food production is critical to meeting growing global food needs in a context of climate change and natural resource scarcity. Agriculture, is the main source of cultivation of food and goods through farming, which produces the vast majority of the world's food supply. Crop production will be influenced in multiple ways by climate change itself, as well as by our efforts to limit the magnitude of climate and adapt to it. Agriculture plays a vital role in not only food production and supply but is associated with many of our traditions, values and in many of the Indian states festivals are related to harvest. There are large numbers of plant and animal products, which are used for our livelihood, including grains, pulses, spices, honey, nuts, cereals, milk, vegetables, fruits, egg, meat, chicken. In previous units, we have discussed about the role of agriculture in food security and here we shall discuss agriculture planning and the different revolutions that have led to reversal of famine.

13.1 OBJECTIVES

After studying this unit you will be able to,

- Discuss the link between agriculture and nutrition.
- Explain the impact of green revolution.
- Describe the concepts and objectives of blue revolution.

- List the phases of white revolution.
- Explain the mission of yellow revolution.

13.2 OBJECTIVES OF AGRICULTURE PLANNING

We have discussed in UNIT -VII in detail about agriculture planning and the need for it. Here let us high light the important objectives of agriculture planning.

Agriculture, which is the production of food and goods through farming, is central to sustainable development. The agriculture sector is critical for generating employment in rural areas, supporting the economy in farming communities, and providing food and nutritional security. Agriculture has a direct impact on deforestation, air and water pollution and zoonotic and foodborne disease. For promoting essential health outcomes the agricultural sectors will be the main source. The adequate good nutrition is vital factor for improving the good health and enhancement of population wellbeing. Iron and calcium deficiency have been identified as cause for maternal death which leads to increased risk of pre-eclampsia and anemia and malnutrition is underlying cause for 45% of child deaths. So, the agricultural sectors can collaborate to improve nutrition security for women and children and health outcomes. Thus, the main objective of agriculture planning is to supply food to the entire population, thereby ensuring food security and improving the nutritional status of the masses.

Agricultural policies to improve food processing, storage and preservation, can help to ensure food produces that retain nutritional value, safety of foods and increase in shelf life and the availability of healthy foods through different seasons. Fertilizers, and food processing methods all affect nutritional quality of food produce. For instance high use of nitrogen fertilizers can reduce vitamin C content in fruits and vegetables. Creating markets for smallholder farmers, particularly for nutritious foods, can promote their production, thereby increasing nutrition security for the vulnerable while contributing to their profitable employment. Promoting nutrition sensitive crops among smallholder farmers has proved successful. While cash cropping has the potential to improve nutritional status through improved productivity and increased income, it may drive farmers who now need to purchase food to replace high quality foods with less nutritious foods. A study on the effect of cash crop production in Gambia, Guatemala, Kenya, Malawi, the Philippines, and Rwanda notes that while cash crops schemes increased household income they did not improve nutritional status of preschool aged children. Cash crop schemes can be more effective when accompanied by nutrition interventions programmes such as nutrition education. Facilitating product diversification can improve nutrition security by allowing for more diverse food consumptions while protecting small holder farmers against price shocks and the impact of climate change. In Senegal efforts to improve nutrition outcomes included promotion of small livestock and production of fruits and

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vegetables to enhance dietary diversification, increase nutrient intake (particularly during lean season); and village grain banks to enhance access to and availability of the principle staple foods during the lean season.

Efforts to empower women by ensuring access to land, productive resources, income opportunities, extension services and information, credit, labour and time-saving technologies can also have an important impact on agriculture and health. The government prioritized women's income-generating activities such as home gardening, poultry raising, beekeeping and vegetable growing, among other interventions to sustain health and income.

Revolution in India marked the beginning of a completely new era in various socio-economic fields like agriculture, petroleum etc. Over the years many significant agricultural changes have occurred in order to supply enough food for the growing human population. Let us discuss each revolution in detail in the following sections.

13.3 GREEN REVOLUTION

Throughout history there have been many revolutions that have occurred and changed human lives, such as the American Revolution and the Industrial Revolution. The Green Revolution was the notable, with increase in cereal-grains production in Mexico, India, Pakistan and Philippines and other developing countries in the 1960s and 1970s. The Green Revolution was launched by research establishments in Mexico and the Philippines that were funded by the governments of those nations, international donor organizations, and the U.S. government. Similar work is still being carried out by a network of institutes around the world.

In the 1940s, Norman Borlaug developed a strain of wheat that could resist diseases, was short, which restricted damage by wind, and could produce large seed heads and high yields. He introduced this variety of wheat in Mexico and within twenty years the production of wheat had tripled. This allowed for more food cultivation for people in Mexico and also made it possible for Mexico to export their wheat and sell it in other countries. Norman Borlaug helped introduce this high-yield variety of wheat to other countries, who were in need of increased food production, and he eventually won a Nobel Peace Prize for his work with developing high-yield crops and for helping prevent starvation in many developing countries and is honoured as father of green revolution.

With all these exposures and as suggested by the team of experts of the Ford Foundation in its report "India's Crisis of Food and Steps to Meet it" in 1959 the Government decided to shift the strategy followed in agricultural sector of the country. The new technology in agriculture was tried out in 1960 – 61 as a pilot project in seven selected districts of India and this programme was named Intensive Area Development Programme, extended to other districts on an experimental basis and was called Intensive Agriculture Areas Programme (IAAP). Thus, as a result both production and productivity per hectare have increased

considerably. This qualitative and quantitative improvement in Indian agriculture, with the initiatives of Government is scientifically termed as “GREEN REVOLUTION”.

Green revolution introduced farmers to hybrid strains of wheat, rice, and corn (maize) and the adoption of modern agricultural technologies, including irrigation and heavy doses of chemical fertilizer. The Green Revolution was a period when the productivity of global agriculture increased drastically as a result of new advances. During this time period, new chemical fertilizers and synthetic herbicides and pesticides were manufactured. The chemical fertilizers made it possible to supply crops with extra nutrients and, therefore, increase yield. The newly developed synthetic herbicides and pesticides controlled weeds, deterred or killed insects, and prevented diseases, which also resulted in higher productivity.

In addition, high-yield crops were also developed and introduced. High-yield crops, are crops that are specifically designed to produce more overall yield. A method known as multiple cropping was also implemented during green revolution that lead to higher productivity. Multiple cropping is when a field is used to grow two or more crops throughout the year, so that the field constantly has something growing on it. These new farming techniques and advances in agricultural technology were utilized by farmers all over the world, and when combined, intensified the outcomes of green revolution. In short, green revolution can be defined as large increase in crop production in developing countries achieved by the use of artificial fertilizers, pesticides, and high-yield crop varieties.

Elements of Green Revolution

- 1. Continued expansion of farming areas:** The area of land under cultivation was being increased right from beginning, but this was not enough to meet the rising demand, proportional to population rise. Hence, other methods of technical advancements were required. Yet, the expansion of cultivable land also had to continue. So, the green revolution continued with this quantitative expansion of farmlands.
- 2. Double-cropping existing farmland:** Double-cropping was a primary feature of greenrevolution. Instead of one crop season per year, the decision was made to have two crop seasons per year. The one-season-per-year practice was based on the fact that there is only natural monsoon per year. This was correct. So, there had to be two "monsoons" per year. One would be the natural monsoon and the other an artificial 'monsoon'. The artificial monsoon came in the form of huge irrigation facilities. Dams were built to arrest large volumes of natural monsoon water which were earlier being wasted. Simple irrigation techniques were also adopted.

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3. Using seeds with superior genetics: This was the scientific aspect of the green revolution. The Indian Council for Agricultural research was re-organized in 1965 and it developed new strains of high yield variety (HYV) seeds, mainly wheat and rice and also millet and corn. M. S. Swaminathan, an Indian geneticist and administrator, known for his role in India's Green Revolution, under whose guidance high-yield varieties of wheat and rice were planted. He is recognised as Father of green revolution in India. The other legend in the history of green revolution of India is Dr. M.P. Singh, who was very instrumental in introducing High Yielding Seeds [HYS] to agricultural world of the country. The use of HYS provided the success platform for the green revolution in India.

4. Package Programme: The new technology adopted in the Indian agriculture during mid-1960s consists of several ingredients like HYV seeds, chemical, fertilizers, pesticides, irrigation and improved machines and tools like tractors, pump sets etc. All these things are together termed as, package programme.

If any one of these elements are missing there will be no significant remarkable impact on productivity per hectare of land.

Effects of Green Revolution

Green revolution has led to tremendous increase in food grain productivity and improvements in agricultural scientific advancements had been seen. Let us list and discuss them:

(i) Increase in Food Grain Productivity:

As a result of new agricultural strategy, food grains output substantially increased from 81.0 million tonnes in the Third Plan (annual average) to 203 million tonnes in the Ninth Plan (annual average) and further to 212. 0 million tonnes in 2003-04. Total food grain production India is estimated at 281.37 million tonnes during 2018-19. High yield variety production was restricted to only five crops – wheat, rice jowar, bajra and maize. Therefore, non- food grains were excluded from the ambit of the new strategy.

Wheat has made rapid strides with its production increasing from 11.1 million tonnes (Third Five Year Plan) to 71.3 million tonnes in the Ninth Plan. The production of wheat touched a high level of 72.1 million tonnes in 2003-04, the overall contribution of wheat to total food grains has increased from 13 per cent in 1950 – 51 to 34 per cent in 2003-04, while in 2019, 99.12 million tonnes of wheat production has been recorded.

The average annual production of rice rose from 35. 1 million tonnes in the Third Plan to 87.3 million tonnes in the Ninth Plan. It stood at 87.0 million tonnes in 2003-04 and million tonnes in 2019.

In addition to producing larger quantities of food, the green revolution was also beneficial because it made it possible to grow more crops on roughly the same amount of land with a similar amount of effort. This reduced production costs and also resulted in cheaper prices for food in the market.

(ii) Scientific Cultivation:

A very important effect of green revolution is that traditional agricultural inputs and practices have given way to new and scientific practices. Instead of farm seeds, farmers are now using HYV seeds. Traditional fertilizers are replaced by chemical fertilizers.

(iii) Change in Cropping Pattern:

Two changes are significant. First, the proportion of cereals in the food grains output has increased and the proportion of pulses has declined. Second, the proportion of wheat cereals has increased while that of coarse grains has declined.

(iv) Development of Industries:

Green revolution has benefited the industrial development. Many industries related with agriculture, machinery, chemical fertilizers, pesticides, insecticides etc., have come up to meet the growing demand for these commodities.

(v) Change in Attitude:

A healthy contribution of green revolution is the change in the attitudes of farmers. Our farmers have now begun to think that they can change their misfortunes by adopting new technology. Unlike past, they are now giving up traditional agricultural practices for scientific practices. Increase in productivity in these areas has enhanced the status of agriculture from a low level subsistence activity to a money-making activity. The desire for better farming methods and better standard of living is growing up.

Limitations of Green Revolution

In spite of several achievements, the green revolution has certain limitations.

(i) More inequality among farmers:

The new technology requires a huge amount of investment which can be only, afforded by the big farmers. Hence, these farmers are getting the absolute benefits of the green revolution and became comparatively richer than small farmers. This increases inequality in rural India.

(ii) Regional inequality:

Benefits of the new technology remained concentrated in wheat growing area like Punjab, Haryana and Western Uttar Pradesh, since green revolution remained limited to wheat for a number of years. On account of the above reasons new agricultural strategy has led to an increase in regional inequalities.

(iii) The question of labor absorption:

The adoption of new technology and increased mechanization had reduced labour absorption in agriculture.

(iv) Undesirable social consequences:

Some micro level socio-economic studies of green revolution areas have revealed certain undesirable social consequences of the green revolution. Many large farmers have evicted tenants as they now find it more profitable to cultivate land themselves. Thus, a large number of tenants and share-croppers have lost their lands and have been forced to

join the ranks of agricultural laborers. Wetlands have also attracted outsiders (non-agriculturists from nearby towns to invest capital in buying farms.

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(v) Health Hazards:

Increased mechanization that has accompanied the modernization of farm technology in green revolution areas carries with it the risk of in capitation due to accidents. The attitude of the Government towards the problems of treatment and rehabilitation of victims of accidents on farm machines is that of total ambivalence. Meagre compensation is provided to victims.

13.4 BLUE REVOLUTION

The concept of rapid increase in the production of fish and marine product is called as blue revolution. Realizing the immense scope for development of fisheries and aquaculture, the Government of India has restructured the Central Plan Scheme under an umbrella of Blue Revolution, provides for a focused development and management of the fisheries sector to increase both fish production and fish productivity from aquaculture and fisheries resources of the inland and marine fisheries sector including deep sea fishing.

The blue revolution envisages transformation of the fisheries sector with increased investment, better training and development of infrastructure on the lines of green revolution. Blue revolution aims to double the income of the fishers and fish farmers with inclusive participation of the socio-economically weaker sections and ensure sustainability with environment and bio-security. It is targeted to achieve an annual production of 15.00 million metric tonnes by 2020. The key goal would be to substantially increase the share of Indian fisheries in the export market. There is a remarkable emergence of aquaculture as an important and highly productive agricultural activity. Aquaculture refers to all forms of active culturing of aquatic animals and plants, occurring in marine, brackish, or fresh waters. Fish farming is a relatively intensive enterprise. It commonly involves the management of all stages in the life cycle of the cultivated fish, from the production of eggs and larvae, to growth and eventual harvest of high-quality, market-sized fish. Various species of fish are grown in aquaculture, using a variety of cultivation systems. Many species of molluscs, crustaceans, and other invertebrates are grown in aquaculture, particularly in Asia, but increasingly in other regions as well. Seaweeds are also grown in large quantities for use as food and as feedstock for the production of alginates and other industrial products.

Aquaculture provides many benefits to people, mostly through access to a large production of nutritious, high-quality foods. However, as with terrestrial agriculture, there are adverse environmental impacts of aquaculture. The most important effects are ecological, and are associated with the conversion of natural ecosystems into intensively managed aquaculture ecosystem. Father of Blue Revolution is Dr. Hiralal Chaudhary.

Objectives

- To increase the overall fish production in a responsible and sustainable manner for economic prosperity.
- To modernize fisheries with special focus on new technologies.
- To ensure food and nutritional security.
- To generate employment and export earnings.
- To ensure inclusive development and empower fishers and aquaculture farmers.
- To have a concern on the biosecurity and environmental issues.

Advantages

- Providing food security.
- Providing nutrition security.
- Providing employment, fishing, aquaculture and a host of allied activities are a source of livelihood to over 14 million people in India.
- A major foreign exchange earner.

Disadvantages

- Degradation and loss of natural coastal resources.
- Antibiotics, herbicides and other medicines that are used in aquaculture ponds contaminate local waters and species.
- Accumulation of organic matter, both in the form of unconsumed feed and faeces. When aquacultural activities are conducted directly in the marine or brackish environment lead to a process of eutrophication, with associated depletion of oxygen in the water bodies.
- Coastal areas are exposed to erosion, flooding, increased storm damage, altered natural drainage patterns, increased salt intrusion and removed critical habitats for aquatic and terrestrial species due to conversion of mangrove swamps and wetlands into shrimp farms.
- Outbreaks of pathogens not only wipe out a cultured fishery but they also can infect nearby wild species, which can result in a collapse of these wild fisheries.

Check Your Progress

1. Describe the elements of green revolution.
2. List the objectives of blue revolution.

13.5 WHITE REVOLUTION

After the huge success of world renowned Green Revolution in India that resulted in tremendous increase in production of rice and wheat, the India government took up “Operation Flood” Programme with a motive of increase in milk production and make India one of the largest producers of milk in the world. Indeed, this programme was a huge success and the

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entire world knows it as “The White Revolution”. White revolution in India also known as Operation Flood was a rural development programme started by India's National Dairy Development Board (NDDB) in 1970 to make our country self-sufficient in milk. Today around 12 million farmers in more than 22 states across the country own around 250 dairy plants handling around 20 million liters of milk a day which is a remarkable achievement. It resulted in making India the largest producer of milk and milk products, and hence is called as the White Revolution of India. The milk production in India amounts to 176.3 million tonnes in 2017-18, which is a remarkable quantity, with per capita availability of 375gms/day. It also helped in reducing the malpractices by milk traders and mercenary merchants and ultimately helping in eradicating poverty.

Operation Flood helped the dairy farmers, in directing their own development, by empowering them with the controls of the resources that they create. A 'National Milk Grid' was formed that connected milk producers throughout the country along with the consumers of more than 700 towns and cities. This helped in reducing seasonal and regional price variations ensuring consumer satisfaction and at the same time ensuring that the producers get a major share of the price that consumers pay. The bedrock of Operation Flood is village milk producers' cooperatives, which procure milk and provide inputs and services, making modern management and technology available to members.

The father of the White Revolution is Verghese Kurien. He founded Amul, one of the largest milk producing companies in Anand, Gujarat, India. Kurien, along with his friend H. M. Dalaya invented the process of making milk powder and condensed milk from buffalo milk. Many companies were started under his leadership and former Prime Minister Lal Bahadur Shastri created the National Dairy Development Board based on Amul's management, resource and infrastructure arrangements.

Objectives

- Increase milk production ("a flood of milk")
- Augment rural incomes
- Offering Fair prices for consumers.

There were several other big Co-operatives that empowered and transformed Operation Flood into White Revolution. Operation Flood was implemented in three phases.

PHASE I (1970-1980)

Traditionally, India has been an importer of dairy products. Phase I was financed by the sale of skimmed milk powder and butter oil gifted by the European Union through the World Food Programme. NDDB planned the programme and certain well defined aims were kept in view for the successful implementation of the programme. Improvement of milk marketing in the organized dairy sector in the

metropolitan cities- Mumbai, Kolkata, Chennai and Delhi was one such step to accomplish the goals.

PHASE II (1981-1985)

Starting from 1981, the Phase II of Operation Flood lasted till 1985. It increased the number of milk sheds from 18 to 136. It was attributed to the fact that milk outlets were expanded to 290 urban markets. By the end of second phase, a self-sustaining system was set up that included 43,000 village cooperatives along with 4,250,000 milk producers. Domestic milk powder production also increased from 22,000 tons in the year 1980 to 140,000 tons by 1989. All of the increase in production was solely due to the dairies set up under Operation Flood. Ultimately, direct marketing of milk by these cooperatives increased by several million liters a day.

The European Economic Community, the World Bank, and India's National Dairy Development Board sponsored the operation flood. The United Nations Development Programme provided technical assistance by sending foreign experts, consultants, and equipment to India. Agricultural extension, social (community-based) forestry, agricultural credit, dairy development, horticulture, seed development, rain-fed fish farms, storage, marketing, and irrigation are supported by the World Bank and its affiliates.

PHASE III (1985–1996)

Operation Flood which started in 1970, concluded its third Phase in 1996. Phase III enabled dairy cooperatives to expand and strengthen the infrastructure required to procure and market increasing volumes of milk. Veterinary first-aid health care services, feed and artificial insemination services for cooperative members were extended, along with intensified member education. Operation Flood's Phase III consolidated India's dairy cooperative movement, adding 30,000 new dairy cooperatives to the 42,000 existing societies organized during Phase II. Milk sheds peaked to 173 in 1988-89 with the numbers of women members and Women's Dairy Cooperative Societies increasing significantly.

The Women's Dairy Cooperative Leadership Programme (WDCLP) was launched in 1995 as a pilot programme for strengthening the dairy cooperative movement by significantly making the women to participate members and as leaders in the governance of cooperative societies, unions and federations.

NDDDB provides assistance to milk producers' cooperative unions in conducting several activities to make the result with WDCLP objectives. The WDCLP encourages cooperative milk producers' unions to identify women staff to participate in training designed to develop their latent potential. In the village, a key strategy is

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training and positioning a local woman as a resource person to encourage and support women's involvement in their dairy cooperative.

This Phase III gave increased emphasis to research and development in animal health and animal nutrition. Innovations like vaccine for Theileriosis, bypassing protein feed and urea-molasses mineral blocks, all contributed to the enhanced productivity of milk in animals.

Advantages

- Genetic improvement of milch animals had been made possible by cross-breeding.
- Increase in the sustainable production of milk.
- Increase in the quality of milk goods.
- Due to the high production of milk, India became one of the most notable exporters of milk and dairy products in the world market.
- Helped provide employment to the 13.4 million people, out of which 3.7 were women.
- Played a major role in the progress of the rural economy. There is no exaggeration in saying that White Revolution is the cause of prosperity in many of the Indian villages.

Disadvantages

- Because of small holdings and scattered milk production, the collection and transportation of milk, in good quality, to markets have become difficult, leading to an inefficient utilization of milk products.
- Quality of milk is adversely affected due to increased production.
- Because of inadequate marketing facilities, most of the marketable surplus is sold in the form of ghee which is the least remunerative of all milk products.

13.6 YELLOW REVOLUTION

Yellow Revolution is associated with the objective of achieving self-reliance in the production of oil seeds, was launched in 1987. Sam Pitroda is regarded as father of Yellow Revolution. Oil seeds technological mission was introduced for ensuing optimum utilization of production, processing, management and

technology in oil seed crops like mustard, sesame. Yellow revolution has increased the production of oilseeds in India seven folds from 5 million tonnes in 1950 to 38 million tonnes in 2019.

India is among the largest oil economies in the world. The country also occupies a distinct position in terms of diversity in annual oilseed crops. The prevailing agro-ecological conditions have been favorable for growing several important annual oilseeds, of edible seeds namely, groundnut, rapeseed-mustard, soybean, sunflower, safflower, sesame and niger and non-edible oilseeds castor. In addition, a wide range of other minor oilseeds and oil bearing tree species add to the diversity as well as oilseed production in the country. India contributes a large share to the global castor production {76.9percent) and also a substantial one to production of sesame {31.2 per cent) and groundnut {25.1 percent).

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Objectives

- Improvement of crop production and protection technologies for realizing higher yields and profit to farmers.
- Improvement of processing and post-harvest technology to minimize the losses and increase the oil yield from both traditional and non-traditional sources of oilseeds.
- Strengthening the input support system to ensure availability of right kind of seed, fertilizers, pesticides, irrigation, credit, etc. and to bring awareness among farmers about the potential of the farm worthy technology through massive transfer of technology programmes.
- Improvement of post-harvest operations for effective procurement, handling, disposal including price support system to farmers and financial and other supports to processing industry.

Advantages

- Strong socio-economic and political will has made us become self-sufficient in vegetable oils.
- Biodiversity and the matching diversity in agro-ecology and farming situations for various annual oilseed crops has become possible, in spite of the availability of more prospective oil crops such as the oil palm.
- Economically viable and sustainable improved oilseeds production technologies generated with the help of strong and vibrant oilseeds research network coupled with encouraging financial and policy supports to research.
- Attractive incentives to the farmers in terms of minimum support prices and input subsidies.
- Institutional support for the overall oilseeds research and development by public, corporate and private sectors, particularly the setting up of the Technology Mission on Oilseeds by the Government of India.

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- Effective implementation, monitoring and periodical evaluation of the technology transfer programmes, especially the "Frontline Demonstrations in Oilseeds" Project.
- Integrated, effective, efficient and transparent functional farmer research-industry-policy interface.

Disadvantages

Although the production of oilseeds had increased considerably, we are still battling a shortage of oil seeds. The integrated oilseeds development programme was initiated in different states with more than 3,000 oilseed societies involving 13 lac farmers and 25 lac hectares of land. Despite these efforts, our oilseeds productivity continues to be as low as 944 kg per hectare when compared to the world level at 1,632 kg per hectare.

At present, there is not much scope to expand the cultivable area under oilseeds. The continuing shortage of cooking oils would suggest that the Oilseeds Technology Mission and growing oil palms have had little impact. These energy-rich crops suffer from a number of constraints as they are grown in poor environment and are susceptible to pests and diseases. Besides, farmers preferred to grow high-yielding cereals to earn higher profits. We are short in oil seeds by 50 percent of our consumption, that's why we have to import edible oils to fulfil our demand. So there is a need of yet another yellow revolution in India.

Check Your Progress

3. Mention the advantages and disadvantages of white revolution.

4. What is yellow revolution?

13.7 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

1. Continued expansion of farming areas: The area of land under cultivation was being increased right from beginning, but this was not enough to meet the rising demand, proportional to population rise. Hence, other methods of technical advancements were required. Yet, the expansion of cultivable land also had to continue. So, the green revolution continued with this quantitative expansion of farmlands.

Double-cropping existing farmland: Double-cropping was a primary feature of green revolution. Instead of one crop season per year, the decision was made to have two crop seasons per year. The one-season-per-year practice was based on the fact that there is only natural monsoon per

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year. This was correct. So, there had to be two "monsoons" per year. One would be the natural monsoon and the other an artificial 'monsoon'. The artificial monsoon came in the form of huge irrigation facilities. Dams were built to arrest large volumes of natural monsoon water which were earlier being wasted. Simple irrigation techniques were also adopted.

Using seeds with superior genetics: This was the scientific aspect of the green revolution. The Indian Council for Agricultural research was re-organized in 1965 and it developed new strains of high yield variety (HYV) seeds, mainly wheat and rice and also millet and corn. M. S. Swaminathan, an Indian geneticist and administrator, known for his role in India's Green Revolution, under whose guidance high-yield varieties of wheat and rice were planted. He is recognised as Father of green revolution in India. The other legend in the history of green revolution of India is Dr. M.P. Singh, who was very instrumental in introducing High Yielding Seeds [HYS] to agricultural world of the country. The use of HYS provided the success platform for the green revolution in India.

Package Programme: The new technology adopted in the Indian agriculture during mid-1960s consists of several ingredients like HYV seeds, chemical, fertilizers, pesticides, irrigation and improved machines and tools like tractors, pump sets etc. All these things are together termed as, package programme. If any one of these elements are missing there will be no significant remarkable impact on productivity per hectare of land.

2. To increase the overall fish production in a responsible and sustainable manner for economic prosperity.

To modernize fisheries with special focus on new technologies.

To ensure food and nutritional security.

To generate employment and export earnings.

To ensure inclusive development and empower fishers and aquaculture farmers.

To have a concern on the biosecurity and environmental issues.

3. Advantages of white revolution

- Genetic improvement of milch animals had been made possible by cross-breeding.
- Increase in the sustainable production of milk.
- Increase in the quality of milk goods.
- Due to the high production of milk, India became one of the most notable exporters of milk and dairy products in the world market.
- Helped provide employment to the 13.4 million people, out of which 3.7 were women.
- Played a major role in the progress of the rural economy. There is no exaggeration in saying that White Revolution is the cause of prosperity in many of the Indian villages.

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Disadvantages of white revolution

- Because of small holdings and scattered milk production, the collection and transportation of milk, in good quality, to markets have become difficult, leading to an inefficient utilization of milk products.
- Quality of milk is adversely affected due to increased production.
- Because of inadequate marketing facilities, most of the marketable surplus is sold in the form of ghee which is the least remunerative of all milk products.

4. Yellow Revolution is associated with the objective of achieving self-reliance in the production of oil seeds, was launched in 1987. Sam Pitroda is regarded as father of Yellow Revolution. Oil seeds technological mission was introduced for ensuing optimum utilization of production, processing, management and technology in oil seed crops like mustard, sesame. Yellow revolution has increased the production of oilseeds in India seven folds from 5 million tonnes in 1950 to 38 million tonnes in 2019.

India is among the largest oil economies in the world. The country also occupies a distinct position in terms of diversity in annual oilseed crops. The prevailing agro-ecological conditions have been favorable for growing several important annual oilseeds, of edible seeds namely, groundnut, rapeseed-mustard, soybean, sunflower, safflower, sesame and niger and non-edible oilseeds castor. In addition, a wide range of other minor oilseeds and oil bearing tree species add to the diversity as well as oilseed production in the country. India contributes a large share to the global castor production {76.9percent) and also a substantial one to production of sesame {31.2 per cent) and groundnut {25.1 percent).

13.8 SUMMARY

To summarize, it is projected that all the revolutions namely, green, blue, white and yellow have been oriented towards tremendous increase in use of technology, high productivity of grains, fishes, milk and oil seeds leading to food security, increased employment opportunities and progress of rural economy. All these revolution has not only benefited agricultural labour but also industrial workers by creating related facilities such as factories and hydroelectric power stations.

13.9 KEY WORDS

- **Green Revolution:** A large increase in crop production in developing countries achieved by the use of artificial fertilizers, pesticides, and high-yield crop varieties.
- **Blue Revolution:** The concept of rapid increase in the production of fish and marine product is called as blue revolution.
- **White Revolution:** White revolution also known as Operation Flood was a rural development programme started by India's National Dairy Development Board in 1970 to make our country self-sufficient in milk.

- **Yellow Revolution:** Yellow Revolution is associated with the objective of achieving self-reliance in the production of oil seeds.

13.10 SELF-ASSESSMENT QUESTIONS

Short Answer Questions

1. Explain the effects of green revolution.
2. Discuss the different phases of white revolution.
3. Define and list the objectives yellow revolution.

Long Answer Questions

1. Elaborate on the process and achievements of green revolution.
2. Second yellow revolution is a must –Justify.
3. Explain blue revolution in detail.

13.11 FURTHER READINGS

- Suryatapas, 2018, Textbook of Community Nutrition, 3rd Edition, Academic Publishers, West Bengal.
- Prabha Bisht, 2017, Community Nutrition in India, Star Publications, Agra.
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- Swaminathan.M.S.2016, From Green to Evergreen Revolution: Indian Agriculture - Performance and Challenges, Cambridge University Press.

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UNIT - 14 A BRIEF REVIEW OF LOSSES OF FOODS IN THE POST- HARVEST PERIOD AND AGENTS CAUSING FOOD SPOILAGE

Structure

- 14.0 Introduction
- 14.1 Objectives
- 14.2 Components and Losses in Post-Harvest System
- 14.3 Prevention of Post-Harvest Loss
- 14.4 Impact of Post-Harvest Loss
- 14.5 Agents causing Food Spoilage
- 14.6 Answers to Check Your Progress Questions
- 14.7 Summary
- 14.8 Key Words
- 14.9 Self-Assessment Questions
- 14.10 Further Readings

14.0 INTRODUCTION

Ensuring food security and long term sustainable growth for a fast growing population is a major global challenge. FAO has estimated that by 2050 the food production has to grow by 70% to feed the world population and also there is a need for an integrated and innovative approach to ensure sustainable food production and consumption. Meanwhile, the number of food insecure population remains unacceptably high each year, massive quantities of food are lost due to spoilage and infestations on the journey to consumers. A more efficient way to meet to the demands of food would not only be to increase the cultivation but also to decrease the post-harvest losses. The term “Post-Harvest Loss” refers to measurable quantitative and qualitative food loss along the supply chain, starting at the time of harvest till its consumption or other end uses. Quantitative being, decrease in total produce weight and volume which can be easily measured and qualitative is decrease in caloric or nutrient component and its acceptability and edibility as a food requires complex system of evaluation. In other words, the post-harvest system should be thought of as encompassing the delivery of a crop from the time and place of harvest to the time and place of consumption, with minimum loss, maximum efficiency and maximum return for all involved.

14.1 OBJECTIVES

After studying this unit you will be able to

- Define and explain the system of post-harvest technology.
- Brief the causes of post-harvest loss.
- Suggest measures to prevent post-harvest loss.
- Describe the agents causing food spoilage.

14.2 COMPONENTS AND LOSSES IN POST-HARVEST SYSTEM

Post-Harvest system starts from the production of crops in the field to the time it reaches the consumer. It is a long value chain and includes processes like Food production, Harvesting, Industrial Processing including packaging and transportation, Distribution and Consumption. Let us discuss each process in detail.

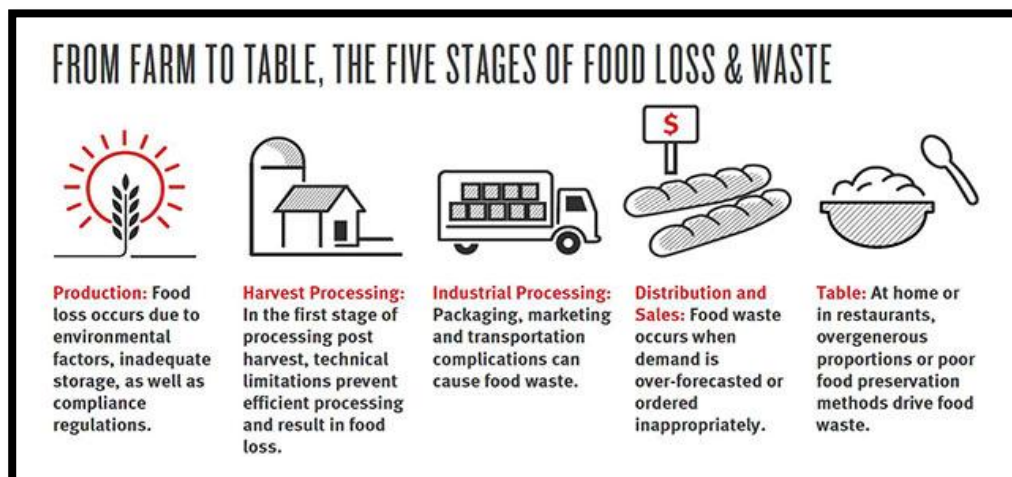


Figure: 14.1 Stages of Food Loss

- Farm Production:** The food loss opening at the early phase of food value chain i.e. during agricultural produce is found mostly in developing countries, which may be due to poor irrigation facilities, improper training for farmers to alternate adoption technologies during water shortage and unfavourable climatic conditions, misuse of manures and pesticides and lack of man power to harvest on time.
- Harvest Processing:** Post-Harvest Handling and Storage considered in this step. Too much of produce and perishable foods if not stored properly post -harvest lead to heavy loss even before reaching the markets. Storage means different methods of preserving foods following harvest in many different ways depending upon the nature of the food crop which guarantees maximum food security. Temperature, Moisture and Oxygen content play a vital

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role in the storage processes. The standards set for the size, weight, colour and appearance are also contributing factors to these wastes. Proper infrastructure, quick transportation, protection from insects and rodents and strengthening the packaging industry will greatly prevent huge losses arising in this stage. The percentage of food loss was projected to be 54% during produce and post -yield and proper education and training to farmers will immensely prevent this loss. The study by ICAR (2013) has appraised that in India, the loss of agricultural produce during harvest and post-harvest phases alone was to the tune of Rs. 92,651 crore.

- c) **Industrial Processing:** The stages of processing, dissemination and consumption contributes to 46% of food cast-off. According to European Commission (2012) the stage of processing alone account for 39% of food waste which might be due to damages that occur during handling and packaging, machinery defects, food safety issues, over-production and transportation. Transportation of food starts from farm to drying site, then to the storage site followed by processing units, packaging sites and finally to the whole sale or the retail market. It is a long journey for the crops and utmost care must be taken to choose the right mode of quick transport to prevent losses due to spoilage. Transport can either be traditional or mechanized. Traditional methods are still followed due to lack of advanced transport systems in rural areas. Now a days the foods travel by air, ship and truck before it reaches us, which means there is possibility for wastage at each point of destination. Food loss also result from handling procedures and excellence compliance, and food products not fulfilling eminence demands from buyers. Packaging of food crops plays a vital role in maintaining the quality and quantity of the food especially during the time of storage and transportation. Improper packing leads to substantial loss of food crops. Packaging should be in such a way that it helps in easy handling, protect the food from external impacts which could be environmental like temperature or even physical or mechanical.
- d) **Distribution:** In the PDS and supermarkets, lots of foods are lost during stacking, distribution due to improper handling, rodents piercing the sacks and spilling. Processed foods which reach the expiry dates before taking place the store for sale are thrown away. Milk is wasted in enormous amounts during distribution.
- e) **Cooking and Consumption:** Food waste from this phase ascend from the homes, hospitals, restaurants, parties and functions. Over production of foods, improper cooking methods, inappropriate stacking for a longer period of time and the excess availability of foods for purchase are the causes for food waste from this category.

The losses at different stages precisely is tabulated below:

Table 14.1 Generic Food Supply Chain and Examples of Food Loss

Stage	Examples of waste
Harvesting	Edible crops left in field, ploughed into soil, eaten by pests; timing of harvest not optimal; crop damaged during harvesting
Threshing	Loss due to poor technique
Drying, Transport and Distribution	Quality and quantity loss of during drying, poor transport infrastructure; loss owing to spoiling/bruising
Storage	Pests and disease attacks, spillage, contamination; natural drying out of food
Primary Processing, Cleaning, Sorting, Hulling, Pounding, Grinding, Packaging, Soaking, Winnowing, Drying, Sieving, Milling	Process losses; contamination in process causing loss of quality.
Secondary Processing, Mixing, Cooking, Frying, Molding, Cutting, Extrusion	Process losses; contamination in process causing loss of quality
Product Evaluation and Quality Control	Product disregarded /out-grades in supply chain
Packaging	Inappropriate packaging damages produces; grain spillage from sacks; attack by pests
Marketing, Selling, Distribution	Damage during transport; spoilage; poor handling; losses caused by poor storage
Post-Consumer	Poor storage/stock management; discarded before serving; poor food preparation, expiration
End of life-disposal of food waste/loss at different stages in supply chain.	Food waste discarded may be separately treated, fed to animals, mixed with other wastes/landfilled

Source: Parfitt et al., 2010

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14.3 PREVENTION OF POST-HARVEST LOSS

Different strategies need to be employed depending upon the type of crops under consideration. To reduce post-harvest loss the first and foremost

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thing is to train the farmers in improved handling and capabilities of using different storage methods since maximum loss happens due to improper storage methods. This will depend upon the type of produce, production scale, climate and the willingness and affordability of the concerned farmers. Some means to reduce post-harvest losses are listed below:

Harvesting: Harvesting at the appropriate maturity stage and at peak quality is an important criteria for any food crop, since quality cannot be improved after harvest. Use of proper harvesting tools is important in case of roots and tubers to avoid mechanical injury which is most common. Training of farmers to use the necessary tools is also recommended to prevent loss during harvesting. Harvesting of perishables like fruits and vegetables is preferred during the early morning hours since exposure of the produce to sun is not desirable. The time of harvest impacts the quality of the produce and also its shelf life.

Handling: Infections by Microorganisms like fungi and bacteria are prevented in roots and tubers mainly by their skin, so any damage to the skin during handling will lead to infestations. It also leads to dehydration and deterioration of its tissues. Hence careful digging of roots and tubers is necessary to prevent post-harvest losses. Similar to roots and tubers the skin of fruits and vegetables are susceptible to easy damage and become a vulnerable site for pathogens. Hence any kind of mechanical injury should be avoided. The number of times the produce is handled should be minimized as much as possible to maintain the freshness and quality.

Threshing/shelling: In case of cereal grains, farmers instead of depending completely on manual methods can make small investments in machinery for threshing and shelling to avoid losses. Some examples of these machinery are maize shellers and rice mechanical threshers.

Packing: Grains should be packed in dry, clean sacks. Roots and tubers should not be over stacked and overfilled in bags in order to avoid and prevent physical damage like abrasion or bruises due to vibration. The packaging should be adequately done with good aeration to minimize losses. Vegetables and fruits should be packed in such a way that it helps in easy handling and also maintains the quality of the product for a prolonged period. Clean, ventilated, smooth containers should be used to avoid physical damages.

Transportation: Transport of any food crop is critical in the view that temperature changes will impact the quality to a great extent. Good air circulation is very important and the selection of a suitable container to transport the produces is of utmost consideration. Synthetic and natural fiber sacks and molded plastic boxes are suitable and preferred for transportation.

Storage: To extend the shelf life and also to maintain the nutritional value systematic sorting coupled with packing and storing is essential. Sorting helps to grade or separate the produces based on their quality. Storage must be dry and well ventilated for cereals and pulses, Yard or crib can be used to dry the harvested crops to avoid losses due to bad weather. Storage should be done accordingly to protect crops from temperature and weather changes and should be free from entry of rodents, birds and insects. For storage of roots and tubers to be successful, choose only undamaged

produces during harvesting, the roots should be devoid of any bruises or pests, select appropriate specially designed storage bins and stores needs checking at regular intervals. Specially constructed pits, clamp stores or mounds with proper ventilation and insulation can also be used for efficient storing. Silos are containers used for storage. Previously, traditional mud silos were used and are now being replaced by metal silos. Metal silos are advantageous in that they can safeguard produces from insects, rodents and pests. However proper drying before storing is a key factor to avoid infestations.

Measures To Regulate Food Loss

Government Initiatives and Policies:

- **MEGA FOOD PARKS:** Links agricultural production to the market by bringing together farmers, processors and retailers to ensure maximizing value addition, minimizing wastage, increasing farmers' income and creating employment opportunities, particularly in the rural sector. The Scheme envisages the creation of support organization structure in a well-defined agricultural and horticultural zone for setting up of modern food processing units.
- **COLD CHAIN, VALUE ADDITION & PRESERVATION INFRA:** It covers pre-cooling facilities at production sites, reefer vans, mobile cooling units as well as value addition centers which include many infrastructural facilities.
- **CREATION OF FOOD PROCESSING & PRESERVATION CAPACITIES:** To increase the level of processing, value addition leading to reduction of food wastage.
- **AGRO PROCESSING CLUSTER:** Effective backward and forward linkages are created by linking groups of farmers to the processors and markets through well-equipped supply chain consisting of modern infrastructure for food processing closer to production areas in order to reduce food waste.
- **FoodTechIndia (FTI)** is a public-private initiative combining the strengths of Dutch agro-food companies, knowledge institutes, governmental agencies and their Indian counterparts to reduce food waste and food wastage in India through the establishment of an improved supply and cold chain.
- **Indian Food Sharing Alliance:** IFSA has been formed by the Food Safety and Standards Authority of India (FSSAI) to help solve India's food waste and hunger crisis by working with various partner organizations, Food Recovery Agencies and NGO's.

Grass Root Education and Training: Joining farmers together in cooperatives or professional associations can help to greatly reduce food losses by increasing their understanding of the market, enabling more efficient planning, enabling economies of scale and improving their ability

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to market what they produce. For instance, improved rice-storage bags provided to farmers in Philippines have helped cut losses of rice by 15 percent. In West Africa, use of solar dryers to extend the shelf life of fruit and tubers is showing promise in reducing postharvest losses. Often, food losses can be significantly reduced simply through training farmers in best practices.

Individual Liabilities:

- Inculcate wise shopping practices.
- Follow proper storage.
- Improve consumption pattern.
- Use left-overs. If not donate to needy.
- Teach children not to waste food in plates.

14.4 IMPACT OF POST-HARVEST LOSS

Post-harvest losses leads to economic as well as environmental impacts and losses.

Economic Loss

- Food scarcity starts to prevail and threat to food security becomes a concern.
- Increase in cost of food products making it unaffordable for certain economic groups of the society.
- Food scarcity in turn will lead to under nourishment.
- Decrease in job opportunities and income to people involved in various parts of the food supply chain.
- Drop in the overall economy of the country since production drop occurs.

Environmental Loss

- Each cycle of food production leads to fertility loss of soil.
- Water resources play a major role in farming and with every cultivation water is polluted and in some places drained.
- Greenhouse gases are emitted leading to pollution and harmful health impacts on humans.

14.5 AGENTS CAUSING FOOD SPOILAGE

Food spoilage is a metabolic process that causes foods to become undesirable or unacceptable for human consumption due to changes in sensory characteristics. Spoilage may occur at any stage along food chain due to insect damage, physical damage, microbial infection or indigenous enzyme activity in the animal or plant tissue limiting the shelf life. The main agents of food spoilage are: Microorganisms, Enzymes, Light, Air, Insects, Rodents, Temperature and Time. Let us discuss each one in detail.

Microorganisms: Microbes are tiny living organisms that can be viewed only under microscope. The main microbes related to foodspoilage are bacteria, yeast and mould, which are present in air, water, hands etc. Microorganisms grow well under warm and moist conditions. Temperature between 5° and 60° C, foods high in protein and low in acid, presence of moisture favour the growth of microbes. Hence it is essential to maintain foods that are perishable like vegetables, fruits, eggs, milk and meat products at low temperatures i.e under 4° C by refrigeration or freezing and non-perishables like cereals and pulses can be sun dried for a day and stored at room temperature, while cooked foods should be heated to 60° C and above so that microbes are killed.

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Enzymes: Enzymes are substances that are naturally present in foods, and are inactive until harvested or animal is cut or maintained at low temperatures under refrigeration. The ripening of fruits is a desirable change caused by the action of enzymes, while over ripening is unwelcoming. When a fruit is cut or vegetable is cut due to the action of oxygen on enzymes the surface turns brown, which is not desirable. The red pigment in meat turns brown when cut due to action of enzymes on oxygen and makes it less appealing and becomes an undesired product.

Light: Exposure of foods to light may not deteriorate food, but causes loss of colour and vitamins. For example riboflavin in milk is lost when exposed to light.

Air: When foods are exposed to air, oxidation occurs. Fats become rancid, on oxidation. Enzymes become active on oxidation. This shows that foods on oxidation causes undesirable changes. Osmosis prevents oxidation.

Insects and Rodents: Insects and rodents, require food for their survival. Hence if food products are stacked at ground levels, in store rooms where holes are present, so as attract these creatures, will damage food, cause food loss and spoilage as well. Also, while transportation the possibility of food loss due to insects and rodents is high similar to storage.

Temperature: As discussed under microorganisms, temperature is an important factor that promote the growth of microbes causing food spoilage. Bacteria are capable of withstanding extremes of temperature. They may be classified according to the temperature ranges as, psychrophiles, which play an important part in the spoilage of food in the refrigerator and in cold storages, kneaded dough left in the refrigerator shows grey or black specks due to the activity of psychrophilic bacteria. The food and canning industry and milk processing plants are greatly affected by thermophilic bacteria-those organisms which are capable of withstanding high temperatures. Hence, foods should be stored accordingly to prevent spoilage.

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Moisture: Moisture causes rapid growth of microbes. Dehydration prevents moisture and preserves food for a longer time preventing food loss.

A detailed study on food spoilage will be done in Food Microbiology and Sanitation.

Check Your Progress

3. Explain the impact of postharvest loss.

4. How do microbes cause food spoilage?

14.6 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

1.Industrial Processing:The stages of processing, dissemination and consumption contributes to 46% of food cast-off According to European Commission (2012) the stage of processing alone account for 39% of food waste which might be due to damages that occur during handling and packaging, machinery defects, food safety issues, over-production and transportation. Transportation of food starts from farm to drying site, then to the storage site followed by processing units, packaging sites and finally to the whole sale or the retail market .It is a long journey for the crops and utmost care must be taken to choose the right mode of quick transport to prevent losses due to spoilage. Transport can either be traditional or mechanized.Traditional methods are still followed due to lack of advanced transport systems in rural areas. Now a days the foods travel by air, ship and truck before it reaches us, which means there is possibility for wastage at each point of destination. Food loss also result from handling procedures and excellence compliance, and food products not fulfilling eminence demands from buyers. Packaging of food crops plays a vital role in maintaining the quality and quantity of the food especially during the time of storage and transportation.Improper packing leads to substantial loss of food crops. Packaging should be in such a way that it helps in easy handling, protect the food from external impacts which could be environmental like temperature or even physical or mechanical.

2.To extend the shelf life and also to maintain the nutritional value systematic sorting coupled with packing and storing is essential. Sorting helps to grade or separate the produces based on their qualityStorage must be dry and well ventilated for cereals and pulses, Yard or crib can be used to dry the harvested crops to avoid losses due to bad weather. Storage should be done accordingly to protect crops from temperatureand weather changes and should be free from entry of rodents, birds and insects.For storage of roots and tubers to be successful, choose only undamaged produces during harvesting, the roots should be devoid of any bruises or pests, select appropriate specially designed storage bins and stores needs checking at regular intervals. Specially constructed pits,

clamp stores or mounds with proper ventilation and insulation can also be used for efficient storing. Silos are containers used for storage. Previously, traditional mud silos were used and are now being replaced by metal silos. Metal silos are advantageous in that they can safeguard produce from insects, rodents and pests. However proper drying before storing is a key factor to avoid infestations.

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3. Economic Loss

- Food scarcity starts to prevail and threat to food security becomes a concern.
- Increase in cost of food products making it unaffordable for certain economic groups of the society.
- Food scarcity in turn will lead to under nourishment.
- Decrease in job opportunities and income to people involved in various parts of the food supply chain.
- Drop in the overall economy of the country since production drop occurs.

Environmental Loss

- Each cycle of food production leads to fertility loss of soil.
- Water resources play a major role in farming and with every cultivation water is polluted and in some places drained.
- Greenhouse gases are emitted leading to pollution and harmful health impacts on humans.

4. Microbes are tiny living organisms that can be viewed only under microscope. The main microbes related to food spoilage are bacteria, yeast and mould, which are present in air, water, hands etc. Microorganisms grow well under warm and moist conditions. Temperature between 5° and 60° C, foods high in protein and low in acid, presence of moisture favour the growth of microbes. Hence it is essential to maintain foods that are perishable like vegetables, fruits, eggs, milk and meat products at low temperatures i.e under 4° C by refrigeration or freezing and non-perishables like cereals and pulses can be sun dried for a day and stored at room temperature, while cooked foods should be heated to 60° C and above so that microbes are killed.

14.7 SUMMARY

It had been well described that, the issue of food losses is of high importance in the efforts to combat hunger, raise income and improve food security in the world's poorest countries. Food losses do not merely reduce food available for human consumption but also cause negative externalities to society through costs of waste management, greenhouse gas production, and loss of scarce resources used in their production. Reducing the postharvest losses, especially in developing countries, could be a sustainable solution to increase food availability, reduce pressure on

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natural resources, eliminate hunger and improve farmers' livelihoods. Avoiding postharvest losses essentially comes down to knowing what techniques to employ, and what to evade throughout each link in the chain. The challenge, however, is putting that knowledge into practice. To overcome postharvest losses, growers, packers, shippers, and retailers must win the race against time and employ strict measures to get the produce from the farm and to your fork while keeping it as fresh as possible.

14.8 KEY WORDS

- **Harvesting:** Harvesting is the process of gathering a ripe crop from the fields.
- **Food Spoilage:** Food spoilage is a metabolic process that causes foods to become undesirable or unacceptable for human consumption due to changes in sensory characteristics.
- **Post-harvest Loss:** The term "Post-Harvest Loss" refers to measurable quantitative and qualitative food loss along the supply chain, starting at the time of harvest till its consumption or other end uses.

14.9 SELF ASSESSMENT QUESTIONS

Short Answer Questions

1. Define and explain the impact of post-harvest loss.
2. Describe the measures to regulate food loss.
3. How to prevent food spoilage?

Long Answer Questions

1. Explain the components and losses in post-harvest system.
2. Describe the agents of food spoilage.
3. Discuss the means to prevent food loss at various stages.

14.10 FURTHER READINGS

- Suryatapas, 2018, Textbook of Community Nutrition, 3rd Edition, Academic Publishers, West Bengal.
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