UNIT 18 MAJOR DEFICIENCY DISEASES-II:
ANAEMIA AND IODINE
DEFICIENCY DISORDERS

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18.1 INTRODUCTION

In the previous unit, you have learnt about protein energy malnutrition and xerophthalmia (the two major nutrition-related disorders) which are common among young children in the rural areas as well as urban slums of our country. In this unit, you will be introduced to another two major deficiency diseases or nutrition-related disorders—Anaemia and Iodine deficiency disorders. These nutrition-related disorders affect a large section of the population particularly women and children (anaemia due to iron deficiency) and pockets of population (iodine deficiency disorders).

This unit deals with various aspects of these deficiency diseases i.e. nature, clinical features, causes and control.

Objectives
After studying this unit, you will be able to

・ describe the nature and causes of nutritional anaemias and iodine deficiency disorders
・ identify the clinical features of anaemias and iodine deficiency disorders and
・ list measures for control of anaemias and iodine deficiency disorders

18.2 NUTRITIONAL ANAEMIAS

Anaemia is a nutritional disorder commonly seen among Indian women of low socio-economic group. It is also observed even among women of higher income group. It is estimated that about 60-70% of pregnant women in the rural areas and urban slums suffer from anaemia. Anaemia is also common in preschool children (1-5 years), school age children and women in the reproductive age group (15-45 years of age).

Anaemia is a condition where haemoglobin levels in blood fall below the normal levels. Haemoglobin, you know, is a pigment present in the blood which gives red colour to the blood and is important for carrying oxygen to the different body tissues in the body.

Haemoglobin is a substance containing iron and protein.
In the case of normal and healthy individuals the haemoglobin in blood is about 15 g per decilitre (100 ml). However, for detecting anaemia, the World Health Organization (WHO) has recommended certain cut-off levels of haemoglobin for different ages below which the individual is considered anaemic. The cut-off level refers to the level of haemoglobin in the blood of an individual (of particular age group) below which that individual will be termed as anaemic. These cut-off levels of haemoglobin are given below (for individuals of various age groups).

<table>
<thead>
<tr>
<th>Age</th>
<th>g/100 ml</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 months to 6 years</td>
<td></td>
</tr>
<tr>
<td>6 years to 12 years</td>
<td>11</td>
</tr>
<tr>
<td>&gt;12 years Male</td>
<td>12</td>
</tr>
<tr>
<td>&gt;12 years Female</td>
<td>13</td>
</tr>
<tr>
<td>Pregnant women</td>
<td>12</td>
</tr>
</tbody>
</table>

Now, you would be interested in knowing deficiency of which nutrient results in anaemia. Anaemia can be due to deficiency of iron which is a part of haemoglobin. In Unit 4, Block 2, you have read that folic acid and vitamin B₁₂ also play a role in blood formation. Deficiency of these vitamins can also lead to anaemia.

Clinical Features: The clinical symptoms of anaemia arise when the transport of oxygen by the blood is insufficient to meet the needs of the body. The symptoms are, therefore, related to physical activity. The following flow chart explains this fact.

As you know, the need for oxygen is increased during any physical activity like walking, running or doing any physical work. Therefore, inability to make sustained physical effort is the common complaint in anaemia. Usual symptoms of anaemia are fatigue, giddiness, breathlessness on exertion, sleeplessness, palpitation and loss of appetite.

Other clinical changes which appear include pallor or paleness of certain parts of the body. Palleness (pallor) is one of the clinical signs based on which anaemia is diagnosed. Paleness of the tongue, conjunctiva (white of the eye) and nail beds is seen in an anaemic person. In normal persons when one examines the eyes by pulling the lower lids down, one finds that the conjunctiva is red. Similar is the case with the tongue. In anaemia, due to reduction of haemoglobin these appear very pale and whitish.

The patient may feel that someone is pricking him/her with pins (pins and needles) on the fingers and toes. Some patients may complain of chest pain due to reduced oxygen supply to the heart muscle. In severe anaemia, the nails of the fingers and toes become brittle and spoon shaped (Figure 18.1). The tongue may appear smooth and glazed due to atrophy (destruction) of the papillae (numerous projections on the tongue).

Severe anaemia can even lead to death. The risk of death is higher in anaemic women particularly during pregnancy and delivery. You know that the normal term of pregnancy is about 9 months. Pregnant women with anaemia are likely to deliver babies before completing the normal term i.e. before 9 months of pregnancy. They usually give birth to low birth weight babies (birth weight less than 2.5 kg). Infection of uterus, kidneys and the urinary tract are more common in anaemic people. In general, anaemic people are at a greater risk of catching infections.

Causes: What are the causes of anaemia? As you know anaemia can be due to iron deficiency or folic acid and vitamin B₁₂ deficiency. The various causes of iron
deficiency anaemia can be clubbed under two main headings—dietary deficits and iron losses from the body. Let us learn about each of them in detail.

a) Dietary inadequacy: Dietary deficit in the body can be due to two reasons—low dietary intake of iron or reduced (low) absorption of iron in the body. As you know, iron requirement is high in the body in certain physiological conditions especially in infants, children and women in reproductive years (as a result of menstruation, pregnancy and lactation). If iron intake during these periods of life is not adequate, obviously anaemia can set in.

You may be surprised to know that many individuals among these do consume enough iron-rich foods, yet they tend to be anaemic. What is the reason for this anomaly? You know that in India because of economic reasons many communities largely consume vegetarian diets. These diets do not contain sufficient absorbable iron (due to the presence of inhibitors). Animal foods from which iron is better absorbed (due to the presence of enhancers) are expensive and generally not consumed in most families in India due to religious and socio-economic reasons.

b) Losses of Iron: The second major cause of anaemia is increased loss of iron from the body. In adult women loss of iron occurs every month due to menstrual loss of blood. Apart from menstrual loss, loss of iron occurs during pregnancy, delivery and lactation. As you know in pregnancy the woman loses iron to provide for the iron stores of the foetus. During delivery, due to loss of blood and iron content of the placenta, the loss is substantial. Similarly, when the women are breast feeding their babies they lose iron in milk. This poses additional demands for iron on them. If proper care of women is not taken during these periods, it can lead to anaemia.

Iron losses from the body are also more in case of people suffering from hookworm and other worm infestations. This is because worms residing in the small intestine of an individual feed on his/her blood. Heavy loss of iron from the body in conditions of surgery or accident can also lead to anaemia.

Folic acid and Vitamin B12 deficiency: As you have learnt, anaemia can also occur due to the deficiency of folic acid and vitamin B12. Let us now study the causes of deficiency of folic acid and vitamin B12 in Indian diets. You have already learnt in Block 2 that these nutrients belong to the B-complex group of vitamins and play an important role in red blood cell formation. As you know, folic acid is widely distributed in foods. Folic acid deficiency is common only among pregnant women who consume diets which do not contain vegetables, fruits, milk or animal foods right through their lives. We generally, do not come across folic acid deficiency in people who eat foods like green leafy vegetables, fruits and milk regularly which are good sources of folic acid. Women and children are affected by folic acid deficiency more than men.
Anaemia due to the deficiency of vitamin B₁₂ is rather rare. The disorder is due to failure to absorb vitamin B₁₂ either due to lack of a substance called intrinsic factor (normally present in the stomach) or dietary deficiency. As you know, vitamin B₁₂ is present only in foods of animal origin. Dietary deficiency may arise in people who are strict vegetarians or eat no animal products. This is one of the reasons why milk should be added to our diets particularly to those depending on vegetarian diets totally.

**Treatment**: Haemoglobin in blood can be raised by giving iron in the form of tablets. Ferrous sulphate (iron tablets) is the preparation of choice to treat anaemias. *One tablet (Ferrous sulphate 150-180 mg) twice or thrice a day before food is recommended. This may cause certain side effects like constipation, discolouration of stools and gastric upset like nausea. The woman should be clearly told about the possibility of these side effects and be prepared so that she does not discontinue the treatment. In fact, a large number of individuals stop taking iron tablets because of these complaints. Treatment should be continued for at least 3 months after haemoglobin levels return to normal. In the case of infants and children, sweet liquid preparations (syrups) are available. In the case of folic acid and vitamin B₁₂ deficiency anaemia, tablets containing folic acid (1-2 mg) and B₁₂ (10 μg) are given.*

Associated infections should be treated with appropriate antibiotics. In areas where hookworm disease is common, suitable medicines should be given to treat the disease. Simple medicinal iron in the case of individuals with hookworm infestation will not be adequate to treat anaemia.

**Prevention**: Given below are the few preventive measures which can help to prevent anaemias.

a) *Dietary measures*: The most rational method of prevention of anaemia is to ensure consumption of diets adequate in iron by the population. The women, particularly living in villages and urban slums, should be adequately educated about the importance of prevention of anaemia and should be encouraged to consume iron-rich foods regularly. Inexpensive sources of iron are green leafy vegetables (palak, amaranth, etc.), rice flakes, other vegetables like (lotus stem, groundnuts. If these foods are consumed as sources of iron, care should be taken that enough vitamin C-rich and protein-rich foods are consumed along with them (as they enhance absorption of iron). Meat and liver are preferably good dietary sources, if one likes and can afford them.

b) *Fortification of foods*: One of the methods of ensuring adequate consumption of iron through diets is to add iron to a food item, that is consumed by one and all daily. The method by which the nutritive value of diets is improved by the addition of one or more nutrients to a food item is known as fortification of food. The food selected for this should be consumed by all, particularly the needy poorer segments of the populations, with very little daily variation in the quantities consumed. Common salt is consumed by the rich and poor daily in our country. It has been identified as the vehicle for fortification with iron. Studies have shown that consumption of common salt to which iron has been added leads to an increase in haemoglobin levels, thus reducing the prevalence of anaemia. Though this programme has not yet been initiated in the country, this will be one of the approaches to control anaemia in future. Baby foods are also fortified with iron to protect infants fed for long periods on artificial milk formulas from anaemia.

c) *Distribution of iron and folic acid tablets*: You know that by giving iron tablets, the haemoglobin levels in the blood can be raised. One of the approaches, that has been in practice in the country for over 20 years is distribution of tablets containing iron (60 mg) and folic acid (500 μg) to the vulnerable sections of the community (those who are more prone to deficiency disorders)—women, pregnant and lactating women, family planning acceptors (women who have been sterilized or those using intrauterine contraceptive devices. These women may have more menstrual losses) and children (1-3 years). The Government of India has been implementing a programme called National Nutritional Anaemia Control Programme, since the year 1970. Under the programme, the beneficiaries receive 100 tablets of iron and folic acid. This is expected to control the widespread prevalence of anaemia in the
Nutrition-Related Disorders

You will learn more about the two programmes in Block 6. Simultaneously the community should be educated to protect themselves against anaemia by consuming foods rich in iron.

Check Your Progress Exercise 1

1) List the population groups at risk of developing anaemia.

2) Fill in the blanks:
   a) Ninety five per cent of anaemia in India is due to .......... deficiency.
   b) Anaemia arises when the transport of .......... by the blood is insufficient to meet the needs of the body.
   c) In pregnant women, the haemoglobin level below ............. in blood is considered as anaemia.
   d) Milk is a .......... source of iron.

3) Match the following:

   A
   a) Intrinsic factor
   b) Absorption of iron
   c) Common salt
   d) Iron

   B
   i) Oxygen
   ii) B12
   iii) Animal foods
   iv) Fortification
   v) Folic acid
   vi) Haem

18.3 IODINE DEFICIENCY DISORDERS

Iodine deficiency disorders (IDD) present another major health problem in India. About 200 million people are at risk of IDD in our country. It means, they are living in areas where IDD is very common. Isn’t it alarming! Till recently, the disease was observed only in Himalayan and Sub Himalayan belts of India (hilly regions) extending from Jammu & Kashmir in the North to Nagaland in the East. In the recent past, however, newer areas south of Vindhyas in Maharashtra, Andhra Pradesh, Karnataka and Delhi in the north are being identified as regions where IDD is becoming more common.

The term IDD includes a spectrum of disabling conditions affecting the health of humans starting from life in the womb through adulthood resulting from an inadequate dietary intake of iodine.

Causes: Iodine is essential for the normal functioning of an endocrine gland known as the thyroid gland. This gland is located in the front portion of the neck, as indicated in the following figure.
The secretion from the gland a hormone called thyroxine, is very important for normal human development and health. Iodine helps in the formation of thyroxine. When iodine is inadequate, the thyroid gland enlarges in an attempt to produce thyroxine for the body needs.

We require very small quantities of iodine (150 μg per day). You have read in Unit 5 of Block 2 that usually we can obtain this iodine through foods and water. In areas where IDD is very common, the environment is deficient in iodine so that soil, water and foods have greatly reduced amounts of iodine. In mountainous and hilly regions, environmental iodine deficiency occurs due to years of washing of the soil by heavy rains and glaciers. In the case of plains, repeated floods deplete the environment of iodine. As a result, water and all animal and vegetable foods dependent on the soil are deficient in iodine. Thus, when foods which are deficient in iodine are consumed, the diet will also be deficient and this produces iodine deficiency.

Apart from this, certain chemical substances called goitrogens (goitre-producing substances) interfere with utilization of iodine by the thyroid gland. Foods like cabbage and radish are known to contain goitrogens. Consumption of these foods in large quantities in some cases may produce iodine deficiency. There is, however, no evidence, as yet, to state that these foods by themselves produce IDD, at least in India.

**Clinical Features**: Goitre and cretinism are the best known and easily recognizable forms of iodine deficiency. However, you should remember that these are not the only manifestations of iodine deficiency disorders. In fact, the term ‘Iodine-Deficiency Disorders’ includes a spectrum of crippling conditions affecting the health and well being of mankind starting from early in foetal life through adulthood as we mentioned earlier. Other manifestations of iodine deficiency disorders are indicated in Table 18.1.

### Table 18.1: Spectrum of iodine deficiency disorders in approximate order of increasing severity

<table>
<thead>
<tr>
<th>Disorders</th>
<th>Level of severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goitre</td>
<td>Various grades of goitre depending upon the size of swelling</td>
</tr>
<tr>
<td>Hypothyroidism</td>
<td>Varying combinations of clinical signs (depending upon age of onset, duration and severity)</td>
</tr>
<tr>
<td>Subnormal intelligence</td>
<td>Variable severity</td>
</tr>
<tr>
<td>Mental deficiency</td>
<td></td>
</tr>
<tr>
<td>Hearing defects</td>
<td></td>
</tr>
<tr>
<td>Squint</td>
<td></td>
</tr>
<tr>
<td>Spasticity</td>
<td></td>
</tr>
<tr>
<td>Muscular weakness</td>
<td></td>
</tr>
<tr>
<td>Endemic cretinism</td>
<td></td>
</tr>
<tr>
<td>Intrauterine death</td>
<td>(Spontaneous abortion, miscarriage)</td>
</tr>
</tbody>
</table>

*Source: Adapted from Iodine Deficiency Disorders in South-east Asia; SEARO Regional Health Papers No. 10 (chapter 1).*

Let us study about the clinical manifestations of both goitre and cretinism.

**Goitre**: The word ‘Goitre’ means swelling/or enlargement of the thyroid gland.

As you have read, in case of deficiency of iodine in the body, thyroid gland enlarges in order to trap more iodine (whatever is available). The swelling or enlargement can vary in size depending on the severity of the goitre. In fact, you can grade goitre based on the size of the swelling in the neck. At one end is the swelling which is only visible on careful examination with the neck of the patient stretched and at the other
end is the big, monstrous goitre which can be seen even from a distance. The prevalence rate (number of cases in 100 individuals) of goitre increases with age reaching a maximum at adolescence. It is more frequent in girls than boys. In fact, if one wants to find out whether goitre is a major problem in an area so as to start a control programme, the goitre rate over the ages 8-14 years is used as an indicator to know whether an area is endemic (highly affected area) for goitre or not. A prevalence of 10% (i.e. 10 girls out of 100 of this age examined) is taken as an indication that goitre is an important health problem in that particular area.

Cretinism: It is the most severe manifestation of IDD. Cretinism refers to adverse effects of iodine deficiency on the infant and young child. Let us see how cretinism sets in. Iodine deficiency interferes with the brain development of the foetus. This means it can cause irreversible brain damage even before birth. If an infant is born to an iodine deficient mother, he or she is likely to suffer from hypothyroidism. If this condition of iodine deficiency or hypothyroidism continues further after birth the child may suffer from a series of disorders which may include mental retardation, growth failure, speech and hearing defects, neuromuscular disorders, paralysis.

All these defects might lead to a mentally retarded deaf-mute or cretin (a child suffering from cretinism). Fortunately there are very few areas in our country where cretinism is common. However, it has been found that in severely iodine deficient areas more than 80 per cent of children are disabled to some extent due to IDD.

Control: Since IDD is primarily due to reduced intake of iodine, the control strategy aims at ensuring sufficient intake of iodine by the population living in areas where IDD is common. A few methods that have commonly been used to increase the iodine intake of people residing in endemic regions include:

1) Addition of iodine to salt.
2) Use of tablets containing potassium or sodium iodide.
3) Use of iodized oil.

Let us discuss each of these methods separately.
1) Use of Iodized salt: The oldest and the most extensively used method is fortification (enrichment) of common salt with iodine (Potassium iodate). You have earlier learnt that salt may be used for fortification of iron to control anaemia. We consume on an average 10-12 g of common salt every day. For 10 g of common salt about 150 μg of iodine is added. In other words, daily consumption of common salt would ensure daily requirements of iodine. The iodized salt (common salt to which iodine is added) smells, tastes and even looks exactly like the common salt. Now a days, in the market in a number of towns, several brands of iodized salt are available. You would realize that it is difficult to differentiate the same from unfortified common salt. The procedure of iodation is simple and costs little. In India distribution of iodized salt in the endemic areas, is in practice for about 25 years. In these areas entry of non-iodized salt is completely banned by law. However, for various reasons—mainly due to inadequate supplies of iodized salt—salt which is not iodized is being sold in the areas. The Government of India has now decided to make available only iodized salt by the year 1992 so that non-iodized salt is not available in the market. According to the available scientific evidence, consumption of 150 μg iodine per 10 g of common salt per day by humans even in areas where goitre is not common may not be a health hazard.

2) Use of tablets of sodium or potassium iodide: Provision of sodium/potassium iodate tablets to school children and addition of iodine to the drinking water suppliers have been tried in some countries. However, this is not a widely accepted method of administering iodine.

3) Use of Iodized oil: During the last decade, injection of oil, to which iodine has been added has been adapted for the control of goitre and cretinism in areas where the IDD is severe. The advantage is that an injection of 1 ml dose of iodized oil can provide protection to an individual for 3-5 years. But this is more expensive and reaching all those at risk by this method is difficult. It is used as a temporary measure particularly in areas which are not easily accessible and iodized salt may not reach due to communication problems.

You know that giving injections to a large number of people is difficult and the people also may not accept them. Hence, efforts are being made to use iodized oil (oil to which iodine has been added) by mouth for controlling goitre. This will also be equally expensive as injections of oil. But of course the acceptability by the community will be better.

Among the various methods available for control of IDD, salt fortification seems to be the method of choice for long term solution of the problem. In fact fortification of common salt with iodine is the major aspect of India’s National Programme for control of iodine deficiency disorders. Education of the people about the dangers of IDD and creating political will in the country are important steps in this regard. It is only when the community is sufficiently aware of the various dangers of IDD can we succeed in the implementation of the Iodine Prophylaxis Programme where iodized salt is distributed to the communities in the endemic areas. You will learn more about this programme in Unit 23 of Block 6.

Check Your Progress Exercise 2

1) Which are the areas in India where iodine deficiency has been prevalent for years?

2) List the methods of control of iodine deficiency disorders.
3) Fill in the blanks:

a) Iodine is required for formation of...hormone.

b) We require...µg of iodine per day.

c) Substances which interfere with utilization of iodine by the thyroid gland are called...

d) The most suitable method for control of iodine deficiency in India is use of...

e) and...are the most easily recognized forms of IDD.

18.4 LET US SUM UP

In this unit you have learnt about two major nutritional deficiency disorders i.e. 
aemia and iodine deficiency disorders.

Nutritional anaemias are common in women particularly during pregnancy and 
lactation. In India, most of the anaemia is due to iron deficiency. The anaemic 
subjects have easy fatigability, giddiness and breathlessness on physical exertion. 
Paleness of conjunctiva, tongue and nail beds is present. In severe cases, chest pain 
and spoon-shaped nails may be present. Dietary inadequacy, menstrual loss and 
frequent pregnancies in women are important causes. Iron tablets should be given for 
treating cases of anaemia. Nutrition education to consume foods rich in iron and 
distribution of tablets of iron and folic acid to vulnerable groups are important 
measures to prevent anaemia.

Iodine deficiency occurs due to reduction of iodine in the environment i.e. in soil, 
water and foods. It leads to iodine deficiency in the diets. The commonest 
manifestation is swelling of thyroid gland (goitre). Cretinism presents the most severe 
form of iodine deficiency disorder. It is characterized by mental retardation, growth 
failure and deaf mutism. Goitre and cretinism present extreme ends of the spectrum 
of iodine deficiency disorders. Within these two forms of IDD are the several 
others. Iodine deficiency can be prevented by enrichment of common salt with 
iodine. This programme is in operation in the country since the past 25 years. 
Injections of iodized oil can protect population from iodine deficiency for 3-5 years. 
Nutrition education of the community to utilize the services will be important in the 
control of IDD.

18.5 GLOSSARY

Deaf mutism : Inability to speak due to deafness occurring since birth or 
early in life.

Decilitre : 1/10 of a litre or 100 ml.

Deworming : Treatment for removal of worms like in roundworm 
disease, hookworm disease etc.

Endemic : A disease which more or less prevails continuously in a 
given region.

Endocrine gland : Organs that secrete specific substances (hormones) which 
are released directly into the circulatory system. These 
glands influence metabolism and other body processes.

Family planning acceptor : Women who underwent sterilization operation or 
accepted intrauterine devices to prevent pregnancy.
Hypothyroidism: Condition resulting from lower than normal levels of thyroxine.

Intrauterine device: A device which is placed in the uterus of women as a measure for family planning.

Palpitation: Forcible pulsation of the heart perceptible to the patient.

Papillae of tongue: Numerous projections of the mucous membrane on the tongue.

Still birth: Delivery of a dead foetus.

Squint: Abnormality of an eye which does not turn to match the other eye's direction.

Spasticity: Stiffness of the limbs characterized by muscular weakness, walking difficulties and mental deficiency.

Thyroid gland: An endocrine gland located at the front of the neck.

Thyroxine: Active iodine compound made in the thyroid gland and functioning as a hormone.

18.6 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress Exercise 1

1) Pregnant women, lactating women, children under the age of five years and women in the reproductive age group.

2) a) Iron
   b) Oxygen
   c) 11 g per 100 ml
   d) Poor

3) a) ii)
   b) iii)
   c) iv)
   d) v)

Check Your Progress Exercise 2

1) Sub Himalayan belt extending from Jammu & Kashmir in the north to Nagaland in east.

2) Iodization of salt is the simplest method of prevention of IDD. In remote areas intramuscular injection of iodized oil can protect the community for 3-5 years against IDD or sodium/potassium iodide tablet can also be given.

4) a) Thyroxine
   b) 150
   c) Goitrogens
   d) Iodized salt
   e) Goitre, cretinism