



Micronutrient Malnutrition – Detection, Measurement and Intervention: A Training Package for Field Staff

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Food and Nutrition

- All people and animals need food to live, grow and be healthy.
- Food contains different types of nutrients.
- Food contains certain nutrients called macronutrients:
 - Fat
 - Carbohydrate
 - Protein
- Food also contains nutrients called micronutrients:
 - Vitamins
 - Minerals
- A good diet is made up of foods that contain all these types of nutrients – macronutrients and micronutrients.



Nutritional Requirements

For people to be healthy and productive they need a certain amount of nutrients. This is called their nutritional requirement.

- **The amount of energy that people get from their food is measured in kilo calories (kcal).**
- **The average person needs about 2100 kcal each day**
- **17-20 % of this energy should come from fat**
- **At least 10 % of this energy should come from protein**
- **People also need certain amounts of vitamins and minerals**
- **For example the average person should have at least 12 mg of the B vitamin niacin, 28 mg of vitamin C, and 22 mg of iron each day.**



Nutritional Deficiencies

- **Nutritional deficiencies occur when the quantity or quality of food is not sufficient to meet a persons needs.**
- **This may be caused by not having enough food to eat or by infections with bacteria, viruses or parasites.**
- **Infections can increase peoples nutrient requirements and reduce their appetite.**
- **Nutritional deficiencies lead to malnutrition.**



There are several types of malnutrition:

- ***Protein Energy Malnutrition (PEM)*** can lead to acute thinness (wasting) or a long term reduction in child growth (stunting). When the PEM is severe it can lead to *Marasmus* or *Kwashiorkor*. Usually this type of malnutrition is caused by a deficiency in both macronutrients and micronutrients.
- ***Micronutrient Malnutrition*** can occur even if the person is getting enough energy and they are not thin or short. It is usually caused by a deficiency in one or a small number of specific micronutrients.



Micronutrient Deficiency Disease

- **Diseases such as anaemia, scurvy and pellagra are caused by deficiencies in micronutrients. They can be very serious and people can die as a result.**
- **You cannot catch these diseases from being near someone who is affected and you will only get them if your nutrient intake is not sufficient.**
- **Many people in the world suffer from micronutrient deficiencies and anaemia is the most common.**
- **It is important to be able to detect and measure how many people have these problems so that people can be given information on how to try and improve their situation. It can also be used to help health and nutrition programmes adapt to meet the needs of the affected population.**



Nutritional Assessments/Surveys

Nutrition assessments are designed to find out about nutrition problems. They may involve the following:

- **Finding out about where food is obtained, who has access to food and who does not, and how it is used.**
- **Weighing and measuring people to see if they are too thin or too short due to lack of food.**
- **Looking at people to see if they have signs of nutritional deficiencies.**
- **Taking samples of urine or blood to test how many nutrients people have.**

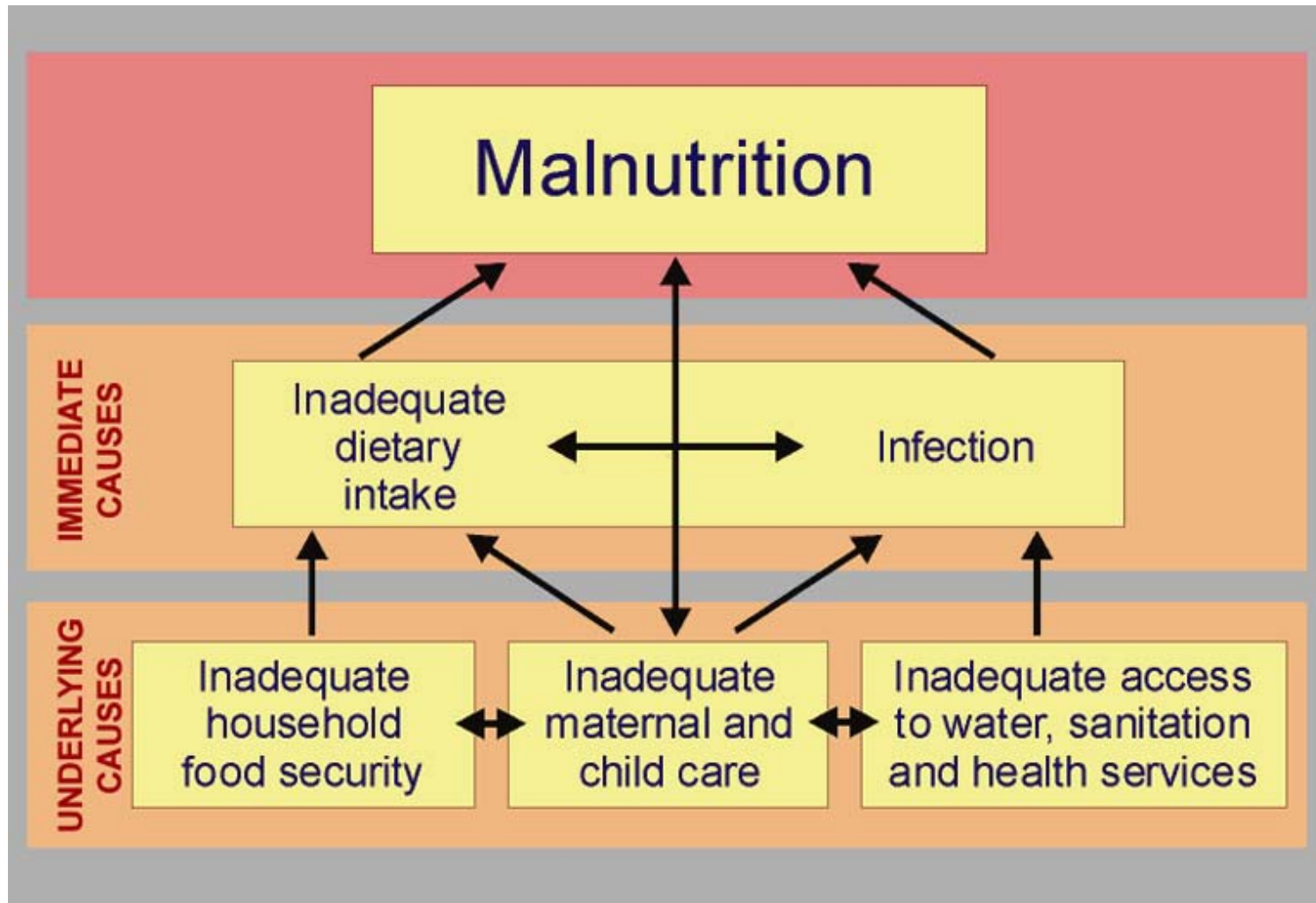


Assessing Micronutrient Problems

- **All health staff and members of survey teams should be able to recognise basic nutritional deficiencies.**
- **It can be very difficult to recognise the signs of some deficiencies which is one reason why it is sometimes necessary to collect samples of blood or urine for testing.**
- **Not all people who are deficient will show clinical signs.**
- **Nutrition assessments can be carried out as part of routine health care or during surveys. They can help to understand the underlying and immediate causes of malnutrition.**



Causes of Malnutrition



Test Questions

1. Name 3 types of macronutrients? *Answer*
2. Give 3 examples of vitamins or minerals that people need in their diet? *Answer*
3. Name 3 things that we may want to find out about during nutrition and food assessments? *Answer*
4. Name two underlying causes of malnutrition? *Answer*



Answers to Test Question 1

The three Macronutrients are *fat, protein and carbohydrate*.
A balance of all of these is necessary for a good diet.

Some examples of rich food sources
of the macronutrients are:

Fat - cooking oil, seeds, meat

Protein - beans, lentils, meat, eggs

Carbohydrate - maize, cassava, yam, rice, wheat

To return to the questions click 

Answers to Test Question 2

People need many different nutrients.

These are just a few examples:

Vitamins:

Vitamin A

Vitamin B1 (Thiamine)

Vitamin B2 (Riboflavin)

Vitamin B6 (Pyridoxine)

Niacin

Vitamin C

Vitamin D

Minerals:

Iron

Calcium

Zinc

Selenium

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Answers to Test Question 3

During a food and nutrition assessment we may want to:

- **Find out where food is obtained, who has access to food and who does not, and how it is used.**
- **Weigh and measure people to see if they are too thin or too short due to lack of food.**
- **Look at people to see if they have signs of nutritional deficiencies.**
- **Take samples of urine or blood to test how many nutrients people have.**

To return to the questions click



Answers to Test Question 4

The Underlying causes of malnutrition are:

- 1. Inadequate household food security**
- 2. Inadequate maternal and child care**
- 3. Inadequate access to water, sanitation and health services**

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End of Section 1

You have now reached the end of section 1.

In the section 2 we will learn a little more about the different micronutrient deficiencies and look at pictures of clinical deficiency.

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To continue to section 2 click



Micronutrient Deficiency Diseases

We are going to look at the following diseases that are caused by nutritional deficiencies:

<i>Disease:</i>	<i>Deficient Nutrient:</i>
1. Anaemia	iron
2. Xerophthalmia	vitamin A
3. Iodine deficiency disorders	iodine
4. Beriberi	thiamine
5. Pellagra	niacin
6. Scurvy	vitamin C
7. Ariboflavinosis	riboflavin
8. Rickets	vitamin D

For each disease we will look at how people get it, how it affects them, how we can recognise it, and what can be done about it.



Anaemia 1

- **Blood contains:**
 - Red blood cells
 - White blood cells
 - Plasma
 - Platelets
- **Haemoglobin is found in red blood cells and gives them their colour. It carries most of the oxygen in the body.**
- **Anaemia is a fall in the level of haemoglobin below the normal (reference) level.**
- **When people become anaemic they don't get enough oxygen to their body and they can become weak and short of breath.**



Anaemia 2

Anaemia can be caused by:

1. Loss of red blood cells
2. Decreased *production* of red blood cells
3. Increased *destruction* of red blood cells

Children, pregnant women, and adolescents are the most likely to suffer from anaemia.



Anaemia 3

- Blood loss can occur *suddenly* due to child birth or an accident or *over a long time* such as through menstruation.
- It can also happen due to parasite infections such as hookworm or schistosomiasis (bilharzia).
- Decreased production of red blood cells can occur for several reasons including:
 - Nutritional deficiencies
 - Infections such as TB and HIV
- Increased destruction of red blood cells can happen due to sickle cell disease, malaria infection and other causes.



Anaemia 4

The body needs many different nutrients to make blood. Deficiency in any of these can cause anaemia:

The three most common nutrient deficiencies that cause anaemia are:

- Iron**
- Folate**
- Vitamin B12**

Other important nutrients for preventing anaemia include: protein, vitamins A, C, and E, copper, riboflavin, and pyridoxine (Vitamin B6)



Anaemia 5

Foods that are rich in iron include:

- **Meat**
- **Fortified cereals**
- **Blended foods**
- **Cashew nuts**
- **Lentils**

Drinking tea with food can reduce the amount of iron that is absorbed by the body and lead to an increased risk of anaemia.



Anaemia can cause the following problems:

- **Fatigue**
- **Faintness**
- **Headache**
- **More likely to get infections**
- **Impaired childhood development**
- **Increased maternal morbidity and mortality**
- **Decreased work capacity**
- **Increased incidence of low birth weight**



Anaemia 7

Anaemia can be detected by testing the blood or by observing how someone looks (clinical signs). Pallor (pale colour) is the main sign to look for. It can affect the:

- **Conjunctiva**
- **Tongue**
- **Palms of the hands**



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Blood can be tested for anaemia using different methods which look at the colour of the blood, the number of blood cells, or use a chemical which reacts with the haemoglobin.

For example:

- **Sahli tube method**
- **Lovibond comparator**
- **Colour chart e.g. WHO colour scale**
- **Haematocrit**
- **Hemocue**



Iron Deficiency Anaemia



Pale mucous membranes in the eye and the tongue are signs of anaemia. You may see these signs in males and females of all ages.



Vitamin A Deficiency 1

Vitamin A is required:

- For good vision, especially at night
- Growth and development
- Protection against infections (measles and diarrhoea)

Vitamin A is present in food in two forms:

- As pre-formed vitamin A in foods from animals
- As pro-vitamin A in some plant foods

Good sources of vitamin A include liver and some fish, red palm oil, carrots, paw paw, and some is also found in yellow maize. Fortified blended foods e.g CSB or WSB also contain vitamin A.

Vitamin A supplements are often given to children in capsules.



Vitamin A Deficiency 2

- **Deficiency in vitamin A can lead to blindness and increased chance of dying from infectious diseases.**

Who is vulnerable to deficiency?

People with a diet lacking in vitamin A rich food.

- **The population group most at risk is pre-school children. Supplementation with vitamin A capsules can reduce the number of children who die by 23%.**
- **Pregnant and lactating women are also at risk of deficiency**



Vitamin A Deficiency 3

To find out if someone is deficient we can:

- Look for clinical signs in their eyes
- Take a blood sample to test in the laboratory

Eye signs of vitamin A deficiency are called Xerophthalmia. They are classified like this:

Night Blindness	XN
Bitot's Spots	X1B
Corneal Xerosis	X2
Corneal Ulceration / Keratomalacia	X3



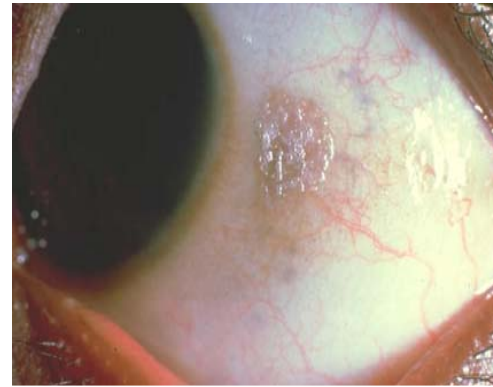
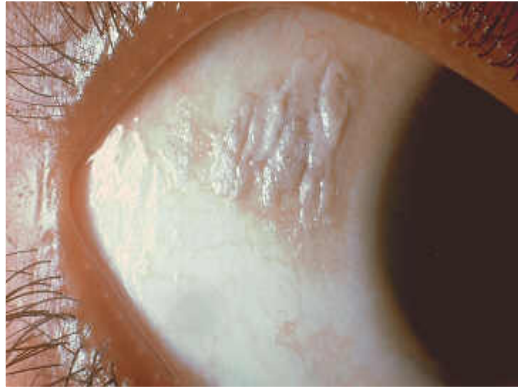
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These signs can be looked for in surveys.

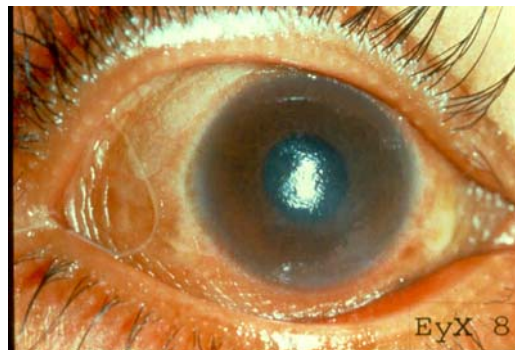
Careful examination and identification is essential.



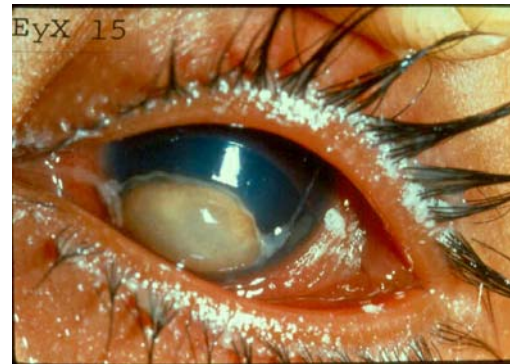
Vitamin A Deficiency – Xerophthalmia



Bitot's spots (X1B) are foamy white areas on the white of the eye. Be careful not to confuse them with other types of eye problems. These signs will most often be seen in children.



Corneal Xerosis(X2)



Keratomalacia (X3)



Iodine Deficiency 1

- **Iodine is a chemical that is found in small amounts in soil and food.**
- **People take in iodine in their diets and it is used by the body to make thyroid hormones. People and animals therefore need to have iodine in their food to be healthy.**
- **When there is not enough iodine in the diet people get *Iodine Deficiency Disorders (IDD)***
- **Iodine deficiency can result in a number of health problems. These include:**
 - **Goitre**
 - **Cretinism**
 - **Reduced mental and physical development**
 - **Increased perinatal and neonatal mortality**



Iodine Deficiency 2

- **To avoid iodine deficiency people can:**
 - **Use iodinated salt - Salt can have iodine added to it. If this is done properly and people use it makes people will have a sufficient supply of iodine through their diet.**
 - **In severe cases oil containing iodine can also be given in a capsule or injected**
- **To find out if someone is deficient in iodine we can:**
 - **Look at their neck to see if they have goitre**
 - **Measure how much iodine is in their urine**
 - **Measure levels of thyroid hormones in their blood**



Iodine Deficiency 3

When looking for goitre we classify what we see as:

Grade 0

Grade 1

Grade 2

No Goitre

Palpable Goitre

Visible Goitre



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Grade 1 goitre cannot be seen but it can be felt

Grade 2 goitre can be seen without feeling the neck



Iodine Deficiency – Goiter examination



Goitre can be examined by looking or by feeling the neck (palpating). If the goiter is not large it may only be seen if the head is tilted gently backwards. The visible goitres seen in the 2 pictures on the top left are Grade 2.



Iodine deficiency can also cause developmental problems in children such as cretinism



Beriberi 1

***Thiamine* is also called Vitamin B1**

- **Thiamine is needed in the diet for the metabolism of energy**
- **Good sources of thiamine include nuts, beans, meat and un-milled cereals**
- **Signs of deficiency manifests after 2 - 3 months of a deficient diet**

A Deficiency in the diet leads to *Beriberi*

Who is vulnerable to deficiency?

- **Population reliant on a diet of polished white rice**
- **Infants breastfed by women deficient in thiamine**



Beriberi 2

There are three main types of beriberi:

- **Infantile beriberi**
- **Dry beriberi**
- **Wet beriberi**

Clinical signs of beriberi include:

- **Wrist and foot drop (dry beriberi)**
- **Oedema (wet beriberi)**
- **Characteristic cry in babies (aphonic or infantile beriberi)**



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Thiamine Deficiency - Beriberi



Oedema seen in the wet form of beriberi. However, caution is needed as it is also seen in general malnutrition where it can be seen in children and adults.



Riboflavin Deficiency – Ariboflavinosis



Lesions of the mouth are seen in riboflavin deficiency. They are called *angular stomatitis* if the fissures are at the corners of the mouth and *cheilosis* if they are elsewhere on the lips.



Ariboflavinosis

Riboflavin is also called Vitamin B2

- **Its main use is in the metabolism of energy**
- **Riboflavin is found in many foods – good sources include pulses, eggs and liver**
- **When people don't have enough vitamin B2 they develop *Ariboflavinosis***

Who is vulnerable to deficiency?

- **Population with a diet deficient in riboflavin - particularly common in rice eating populations**

Clinical signs of deficiency

- **Shiny and dry cracked lips (Cheilosis)**
- **Fissures on the corner of mouth (angular stomatitis)**



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Pellagra 1

***Niacin* is a B vitamin needed for:**

- Metabolism of carbohydrates, proteins and fatty acids
- Generating energy from the food we eat
- Growth

- Niacin is found in many types of food including cereals, pulses, nuts, and meat.
- Niacin can also be made in the body from the amino acid Tryptophan.
- However, the niacin in maize cannot be used by the body unless it is specially treated.
- If people don't have enough niacin in their diet they develop a disease called *Pellagra*



Pellagra 2

Who is vulnerable to deficiency?

- Populations with a diet of maize that is low in meat and dairy products

Clinical Signs of *Pellagra* include:

- Bilateral dermatitis on skin exposed to the sun
- Magenta (purplish) tongue
- Diarrhoea
- Dementia (mental problems)



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Niacin Deficiency - Pellagra

Butterfly
sign



Casal's
collar



A rash (dermatitis) which is on both sides of the body, and on skin normally exposed to sunlight is a sign of pellagra.

Check the face, neck, hands, arms and legs.



Vitamin C is sometimes called ascorbic acid

- **It is required for:**
 - Formation of strong gums and skin
 - Normal growth of bones and blood capillaries
 - Absorption of iron
- **Vitamin C is found in fresh fruits and vegetables such as oranges, paw-paw, tomatoes and potatoes. It is also found in fortified blended foods.**
- **When people don't have enough vitamin C in their diet they get *Scurvy*.**



Who is vulnerable to deficiency?

People with a diet lacking fresh fruit and vegetables are vulnerable to developing scurvy

- **To find out if someone is deficient we can look for *clinical signs* of scurvy or take a blood or urine sample to test in the laboratory**



Scurvy 3

The clinical signs of scurvy are different in infants and other age groups

In adults and adolescents you may see:

- **Bleeding gums (inter-dental papillae)**
- **Peri-follicular haemorrhages (bleeding around base of the hairs)**
- **Bilateral pain on squatting**

In infants you may see:

- **Bleeding gums (inter-dental papillae / teeth eruption)**
- **Reluctance to move due to joint pain**



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Vitamin C Deficiency - Scurvy



Bleeding around the bases of the hair on the legs (Perifollicular hemorrhage) and the gums in between the teeth are signs of scurvy. There may be areas of bruising as seen in second picture. There may also be swelling of the bone joints.



Vitamin D Deficiency (Rickets) 1

***Vitamin D* is important for the growth of bones.**

- **Vitamin D is naturally made in the skin when people are exposed to sunlight.**
- **Vitamin D from the diet is also important, especially when people don't have much sunlight.**
- **The richest food sources are from some types of fish.**



Vitamin D Deficiency (Rickets) 2

- If children don't have enough vitamin D they develop *rickets*
- In women, vitamin D deficiency can contribute to another disease of the bones called *osteomalacia*
- The main clinical signs of rickets are malformations of the bones
 - Bow legs or knock knees
 - Osteo-chondral beading



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Vitamin D deficiency - Rickets



Bow legs



**Harrison's
Groove or
Pigeon Chest**



**Spinal
deformity**



**Beading of the rib cage
(rachitic rosary)**



Test Questions:

1. Name a good food source of vitamin A? **Answer**
2. Name an infection other than hookworm than can lead to blood loss? **Answer**
3. Which people are most likely to get anaemia? **Answer**
4. Name a clinical sign of anaemia? **Answer**
5. Which vitamin deficiency leads to Pellagra? **Answer**
6. Name a clinical sign of scurvy? **Answer**
7. What is the most common clinical sign of iodine deficiency? **Answer**



Answer to Test Question 1

Section 2

Green leafy vegetables, fruit, milk, eggs and liver are examples of good sources of vitamin A.

To return to the questions click



Answer to Test Question 2

Section 2

Many infections may cause this problem. Whip worm, Bilhazia and intestinal schistosomiasis are common causes of blood loss.

To return to the questions click



Answer to Test Question 3

Section 2

Young children, pregnant women, and adolescents are the most likely to be affected by anaemia.

To return to the questions click



Answer to Test Question 4

Section 2

Pale conjunctiva, tongue and hand palms are signs of anaemia. People may also lack energy, and be slow and tired.

To return to the questions click



Answer to Test Question 5

Section 2

***A deficiency in the B vitamin niacin
leads to Pellagra.***

To return to the questions click



Answer to Test Question 6

The clinical signs of scurvy are different in infants and other age groups.

In adults and adolescents you may see:

- Bleeding gums (inter-dental papillae)**
- Peri-follicular haemorrhages (bleeding around the base of hairs)**
- Bilateral pain on squatting**

In infants you may see:

- Bleeding gums (inter-dental papillae / teeth eruption)**
- Reluctance to move due to joint pain**

To return to the questions click



Answer to Test Question 7

Section 2

Goitre is the most common clinical sign of iodine deficiency.

To return to the questions click



End of Section 2

You have now reached the end of section 2.

In section 3 we look at measuring the extent of micronutrient deficiencies and what we can do to try and help.

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Detection of Deficiencies

Micronutrient deficiencies can be detected using a number of different approaches:

- 1. Health and nutrition surveillance**
- 2. Food basket monitoring (on-site distribution monitoring)**
- 3. Routine nutrition surveys**
- 4. Specialised surveys and outbreak investigations**

Each of these has advantages and disadvantages in different situations. If a problem is suspected it may be necessary to obtain expert advice on how to confirm the problem and what to do about it.

Micronutrient deficiencies can be difficult to detect and measure reliably!



Interventions 1

There are several possible approaches to tackling micronutrient deficiencies:

- 1. Adding a nutrient rich food or increasing the size of the general ration**
- 2. Providing fresh food items**
- 3. Promoting the production of vegetables and fruit**
- 4. Providing fortified foods**
- 5. Distributing nutrient supplements**
- 6. Non-food public health interventions**
- 7. Income generation and improving market access**
- 8. Promotion of exclusive breastfeeding and appropriate complementary infant feeding practice**



1. Adding a nutrient rich food or increasing the size of the general ration

Where populations are receiving a general food ration, it may be possible to change or add items to combat particular deficiencies. Improving the general food aid ration has been done in response to specific outbreaks, e.g. inclusion of ground nuts instead of pulses where niacin deficiency was a known problem.

If no nutrient rich foods are available to include in the general ration, increasing the cereal allocation may allow beneficiaries the opportunity to trade the excess and diversify their diet. For this to happen they need access to markets.



Interventions 3

Education of the population about food processing and consumption may be very important in ensuring the best use of the available food.

People should understand the importance of different nutrients, which foods contain them and how to prepare the foods to preserve, as far as possible, the nutritional value.



2. Providing fresh food items

Fresh food items which are micronutrient-rich can be purchased locally and distributed as a complementary part of the general ration. However, the difficulty of transporting and storing fresh foods is a major constraint.



3. Promoting the production of vegetables and fruit

The distribution of seeds, tools and other agricultural inputs may allow populations to grow vegetables and fruit or livestock for home consumption or for sale.

Access to land may be a major constraint, particularly in refugee camps or in areas which are insecure e.g. due to land mines. Water may also be a limiting factor.



4. Providing fortified foods

Fortified commodities such as vitamin A fortified oil and iodised salt are provided routinely in WFP rations and fortified blended foods are often included.

Cereals such as wheat flour can also be fortified with calcium, iron, thiamine and niacin.



5. Distributing nutrient supplements

The following micronutrient supplements may be routinely distributed:

- **Vitamin A supplements to young children every 6 months.**
- **Iron and folate to pregnant women through MCH programmes, and possibly through emergency supplementary feeding programmes.**
- **Multi-vitamins to severely malnourished individuals in therapeutic feeding programmes.**



6. Non-food public health interventions

Good health is very important in maintaining good nutrition. Below are some examples of public health interventions that may be important:

- Vaccination against measles is important in control of xerophthalmia**
- Water, sanitation and hygiene promotion to control diarrhoea**
- De-worming to control anaemia due to intestinal parasites such as hookworm or schistosomiasis**
- Malaria control (e.g. bednets, vector control, etc.) to combat anaemia**
- Health and nutrition promotion activities e.g. sun exposure as protective factor against rickets**



7. Income generation and market access

Income generation schemes can help to improve dietary intake of micronutrients through increasing the purchasing power of beneficiaries and therefore their diet diversity. Micro-credit, enterprise development and improving market access may help in the process. However, the most vulnerable households and individuals may be the ones least likely to benefit.



8. Promotion of exclusive breastfeeding and appropriate complementary infant feeding practice

Exclusive breastfeeding up to about 6 months of age, followed by the introduction of complementary foods with continued breastfeeding are very important for the nutritional status and health of children. Complementary foods for infants should be rich in energy and nutrients as the growing child requires these for successful growth and development.



Test Questions:

1. Name three ways to improve the intake of vitamins? **Answer**
2. What health interventions can help to prevent anaemia? **Answer**
3. Name 3 fortified food items that may be found in the general ration? **Answer**
4. What factors may limit the production of vegetables and fruit? **Answer**
5. Why may improving access to markets for refugees help to prevent micronutrient deficiencies? **Answer**



The intake of vitamins can be improved by:

- 1. Adding a vitamin rich food or increasing the size of the general ration**
- 2. Providing fresh food items**
- 3. Promoting the production of vegetables and fruit**
- 4. Providing fortified foods**
- 5. Distributing nutrient supplements**
- 6. Income generation and improving market access**

To return to the questions click 

To help control anaemia the following health interventions are often useful:

- 1. Malaria control e.g. by use of bed nets or vector control**
- 2. De-worming to remove intestinal parasites such as hookworm or schistosomiasis**
- 3. Treatment of urinary schistosomiasis (Bilharzia)**

To return to the questions click 

Answer to Test Question 3

Foods that are often fortified include:

- 1. Blended foods such as corn soy blend (CSB) or wheat soy blend (WSB).**
- 2. Oil (with vitamin A)**
- 3. Salt (with iodine)**
- 4. Some flours**

To return to the questions click 

**The production of fruit and vegetables
may be limited by:**

- 1. Restricted access to land may be a major constraint, e.g. due to land mines or for political reason.**
- 2. Lack of water.**
- 3. Inadequate of inputs such as seeds and tools.**
- 4. Insufficient knowledge or motivation by the potential workers**

To return to the questions click 

Improving access to markets may help improve nutrient intake by:

- 1. Increasing access to different types of food.**
- 2. Improving the ability to undertake income generating activities such as trade.**

However, the most vulnerable households and individuals may be the ones least likely to benefit.

To return to the questions click 

End of Section 3

Congratulations! You have now reached the end of section 3 which was the last section in this course.

We hope you have enjoyed your session and found it useful.

To return to the contents page click



To go back through section 3 click



To end this presentation click



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