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Introduction

Vitamin A is essential for the health and well-being of people, particularly children. Vitamin A deficiency is one of the most significant nutritional diseases among children. Children who lack vitamin A are more likely to get infections and to die from them than children with enough vitamin A. Vitamin A deficiency also damages the eye and is one of the main causes of blindness amongst young children. For these reasons, vitamin A has received attention worldwide. Many efforts have been made to understand the causes of vitamin A deficiency and ways of preventing and eradicating vitamin A deficiency.

In South Africa, marginal vitamin A deficiency has been identified as a major public health problem. One survey showed that one third of all children under the age of six years have poor vitamin A status. The Department of Health has introduced a number of initiatives to address vitamin A deficiency, including this brochure.

This brochure is intended for **primary health care workers** to acquaint themselves with vitamin A and the prevention and management of vitamin A deficiency in their communities.

Section 1 begins by identifying countries worldwide which have problems of vitamin A deficiency, as well as vitamin A deficiency in South Africa and which provinces are most severely affected. Sections 2-4 explain why the body needs vitamin A to stay healthy and how the diet can provide enough vitamin A to satisfy the body's needs. Section 5 describes some of the many factors which can cause vitamin A deficiency including inadequate breastfeeding and insufficient intake of vitamin A rich foods. This will help you to understand why vitamin A deficiency might be a problem in your community. When you know about the role of vitamin A in keeping the body healthy, you can see in Section 6 how children who do not eat enough food containing vitamin A become ill. In Section 7 you will learn how to identify which individuals are at risk of developing vitamin A deficiency. The various options for treating individuals and the methods of preventing vitamin A deficiency are then described in the final Section.

What is the extent of the problem?

Worldwide occurrence of vitamin A deficiency

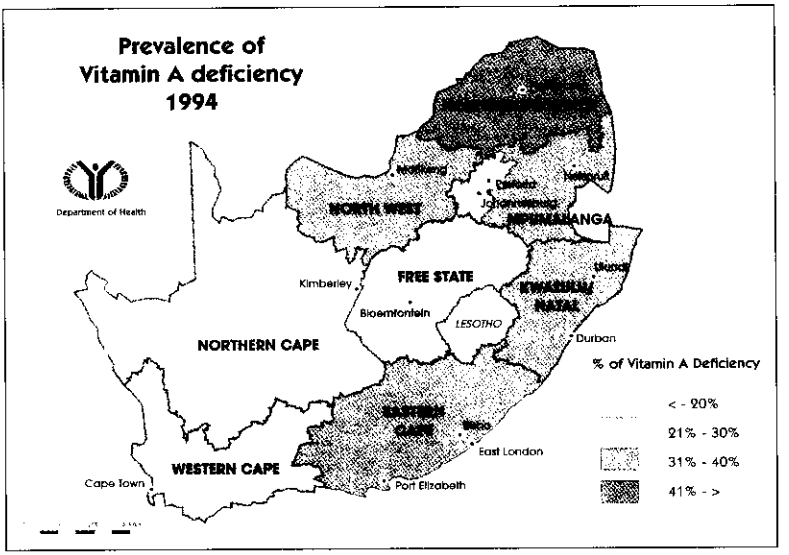
Vitamin A deficiency is a major problem in over 75 countries. Worldwide, vitamin A deficiency is thought to contribute to over 1 million childhood deaths a year and to cause blindness in about half a million children.

The map below indicates the extent of the problem. The darker areas have the worst problems of vitamin A deficiency. As you can see, the map shows that vitamin A deficiency occurs predominantly in poorer countries (Asia, Africa, Central and South America).

South Africa

South Africa has a serious public health problem of vitamin A deficiency. The extent of the problem was defined in 1994 in a survey which found that 33 out of 100 children under the age of 6 years in South Africa had poor vitamin A status. Severe eye disease due to vitamin A deficiency was reported to be uncommon (see Section 6).

The provinces most affected by vitamin A deficiency are Northern Province, KwaZulu/Natal, Mpumalanga, North West and Eastern Cape. Rural areas were found to be more severely affected than urban areas.

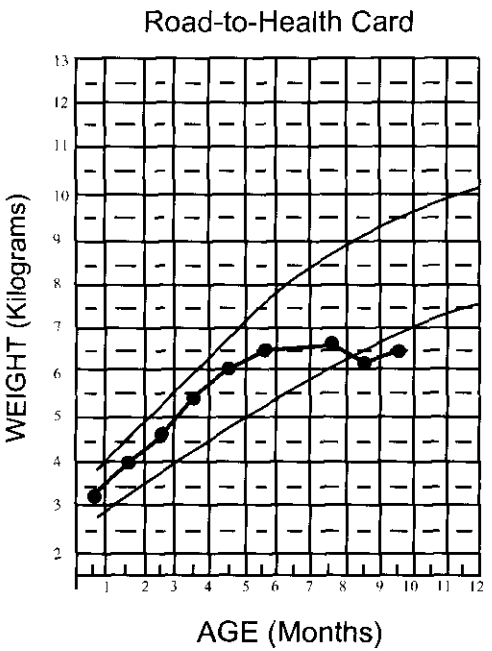


Why do we need Vitamin A?

Vitamin A is essential for the health and well-being of an individual. Vitamin A is especially important for good vision, protecting the body against infection and ensuring adequate growth and development.

Growth

Vitamin A helps children to grow and develop properly. One of the first signs of vitamin A deficiency is loss of appetite. This is soon accompanied by loss of weight and growth faltering. The growth chart below shows a child who has not gained weight for several months and is not growing well.



Resistance to Infection

Vitamin A helps to protect the body against infections. It helps to keep all the cells on the inner and outer surface of the body healthy, so that it is difficult for micro-organisms to enter the body. Vitamin A also plays a major role in the body's immune system.

Vision

The eye needs vitamin A in order to function properly. Vitamin A keeps the front of the eye (the conjunctiva and cornea) healthy and helps the eye to see in dim light.Thus, vitamin A plays an important role in maintaining good eyesight.

What are good food sources of vitamin A?

Vitamin A is present in the diet in two forms:

- As retinol or preformed vitamin A, which is the active form. Retinol is found only in foods of animal origin.
- As carotenoids or provitamin A which achieve vitamin A activity when converted to retinol within the body. The best sources of carotenoids are bright yellow and orange fruits and vegetables and dark green, leafy vegetables.

It is important to remember that although some foods may only have a small amount of vitamin A, they contain **other nutrients** too which are needed by the body and so must not be excluded from the diet. An example of this is bread which is an important source of energy for children.

TABLE 1: Examples of foods which contain vitamin A.

	Excellent sources	Good sources
Foods of Animal Origin	Breastmilk Liver	Kidney Butter/margarine Yellow cheese
Foods of Plant Origin	Sweet Potato Carrot	Spinach Broccoli Butternut Mango Paw paw

Note: Dietary fat (e.g. oil or margarine) is needed for absorbing vitamin A, especially vegetable sources.

Let's tell our mothers and caregivers these handy hints

It's not only what you eat that is important, but also how you prepare it. Remember to tell mothers and caregivers about the following handy hints to help get the most vitamin A from foods.

- Steaming is the best way to get the most vitamin A out of your vegetables.

  Handy hint: Just use a sieve over a pot of boiling water to make a home-made steamer.

- It is better to add vegetables to a small amount of boiling water than to soak them in cold water and then bring them to the boil.

  Handy hint: Boil vegetables for a short period of time only and remember you can reuse the water again in soups and gravies.

- Mashed soft vegetables high in vitamin A (e.g. carrots, butternut, sweet potato and spinach) are good starter foods for your baby.

  Handy hint: Adding a small amount of margarine or oil to your children's vegetables will increase the energy content of the meal, as well as the absorption of vitamin A.

- Drying foods such as mangoes and spinach preserves their vitamin A content. These can be nibbled as snacks or added to soups.

  Handy hint: Remember that sunlight destroys this vitamin so shield your fruit and vegetables using a black sheet to cover a well ventilated crate.

- Overcooking vegetables destroys vitamin A as well as other micronutrients.

  Handy hint: Add vegetables to already boiling water and cook until just soft.

Examples of meals that will satisfy the vitamin A needs of children

Remember to add an extra helping of vitamin A rich foods to the daily diet

0-6 months
Exclusive breastfeeding on demand will satisfy all of babies needs for vitamin A

6-12 months
Once porridge has been introduced to a baby's diet, start adding soft, cooked vitamin A rich foods e.g.

- 3-4 teaspoons of butternut, sweet potato, carrots or pumpkin
- 3-4 teaspoons of soft, mashed fruit such as paw paw, peaches or mango
- 1 teaspoon - 1/4 cup well cooked minced liver can be given once a week

Remember to continue breastfeeding as this provides significant amounts of vitamin A and other important nutrients to your child

1-6 years

- Add a vitamin A rich vegetable daily to the cooked meal e.g.
- 3-6 teaspoons cooked carrots or butternut to samp and beans
  3-6 teaspoons cooked spinach or pumpkin to stiff porridge
- Include a small portion of roasted or fried liver once a week
- Make soups with vitamin A rich vegetables
- Prepare stews with spinach, carrots or butternut
- Encourage children to eat vitamin A rich fruits such as mango, paw paw, sweet melon, apricots and peaches.

7-10 years

The recommendations for adding vitamin A rich foods to the daily diet as suggested for the age groups 1-6 years are applicable to this age group as well. Remember to add one or more of the following to your child's lunchbox where possible!

- 2 medium carrot sticks
- 1 small mango
- 1 medium apricot or peach
- Use yellow cheese as a filler in sandwiches if available
- Mango, paw paw, peach or apricot fruit juice
- Home-dried mangoes, apricots or peaches as a snack!

NOTE:

- Portion sizes are to be used as a guide only and will vary for different ages
- Margerine or oil can be added to vegetables to improve the absorption of vitamin A and also increase the energy content of the diet
- All foods mentioned should be eaten as part of a varied diet

How much vitamin A do you need?

Units of measurement of vitamin A

The amount of vitamin A in food is commonly expressed in International Units (IU) or retinol equivalents (RE). RE is a unit developed to standardise measurement of the variable vitamin A activity of different vitamin A sources

[1 RE = 3.33 IU vitamin A activity from retinol].

Food sources of vitamin A in retinol equivalents (RE)

TABLE 2: Daily requirements of vitamin A according to age (RE)

1200	Lactating mothers
1000	Pregnant females
1000	Males 11 + years
800	Females 11 + years
700	7-10 years
500	4-6 years
400	6 months – 3 years
420	0-6 months

How to use these tables

1. Select the relevant age group from Table 2 and determine the corresponding vitamin A requirements (e.g. children 0-6 months require 420 RE per day).
2. Select a food item or a combination of food items from Table 3 that will provide the appropriate amount of vitamin A (e.g. Breastfeeding on demand will provide all the vitamin A requirements for children 0-6 months of age).

TABLE 3: Vitamin A content of several food items (RE)

1473	1 chicken liver
750	3 heaped teaspoons of sweet potatoes
460	600 ml breast milk
440	3 heaped teaspoons carrots
400	1 small mango
360	3 heaped teaspoons of spinach
260	1/2 cup of sweet melon
160	3 heaped teaspoons of butternut
100	1 matchbox size piece of cheese
100	1 medium apricot
80	1 cup full cream milk (250 ml)
75	2 teaspoons of margarine
40	1 boiled egg

Bread, maize meal, rice and samp contain no vitamin A and should always be eaten together with a vitamin A rich food.

What causes vitamin A deficiency?

There are many factors which contribute to vitamin A deficiency. The most important causes of vitamin A deficiency in children are poor intake of vitamin A from the diet (including inadequate breastfeeding) and frequent infections, especially measles, diarrhoea and respiratory infections (see diagram below).

The examples given below can be used to help you understand how vitamin A deficiency may develop in your community.

Immediate causes

- Insufficient intake of foods rich in vitamin A, especially breastmilk
- Frequent infections especially measles, diarrhoea and acute respiratory infection

Underlying causes

- Breastfeeding for an insufficient length of time
- Inappropriate complementary feeding practices (such as early introduction of solid food of poor nutritional value)
- Low levels of family education, awareness and knowledge of vitamin A

Basic causes

- Lack of resources to produce micronutrient-rich foods
- Failure to consider micronutrient needs in agriculture and health policy-making
- Little or no agricultural land
- Poverty and poor access to markets

Source: Adapted from Gillespie and Mason (1994)

What happens if we don't receive enough?

In South Africa, the eye disease caused by vitamin A deficiency, is not commonly seen. The effects of vitamin A deficiency on growth and infection are far more significant.

Growth faltering

Vitamin A deficiency is associated with reduced appetite, weight loss and failure to grow properly. Children who are malnourished have a lower resistance to infection; they are more likely to become ill than well nourished children. During serious infections such as measles and diarrhoea, children lose a lot of weight, so it is easy to see that infections cause children to stop growing.

Increased number and severity of infections

Children with vitamin A deficiency are more prone to infection, especially gastrointestinal and respiratory infections. The severity of infections, particularly measles, is also greater among vitamin A deficient children (see Figure 1)

Fig. 1

This figure shows a child with early measles characterised by sore and runny eyes

Visual disturbances

One of the earliest signs of vitamin A deficiency is night blindness, an impaired ability to see in dim light. If untreated, this progresses to conjunctival xerosis, bitot's spots, corneal xerosis, corneal keratomalacia and scarring. In its more severe form, vitamin A deficiency causes partial or total blindness, a condition called xerophthalmia. This is the main cause of acquired blindness among young children.

Fig. 2 Child, 4 years old. Chronic Bitot's spots with localized xerosis and dark coloring color of the conjunctivita.

Fig. 3 Child, 3 years old. Keratomacalacia with greyish, jelly like bulging cornea. The iris and lense have pushed forward into the cornea.

Fig. 4 Child, 4 years old. The cornea is completely scarred and the eye is blind

If vitamin A deficiency is not treated, or is treated too late, it may result in severe eye damage and permanent blindness.

A scar of the cornea impairs its transparency and interferes with vision. A perforated eyeball shrinks and leads to complete blindness.

Who is at greatest risk?

All persons who have limited access to vitamin A rich foods are at risk for vitamin A deficiency. Certain groups of people are more prone to develop vitamin A deficiency than others. These include:

Low birth weight and premature babies

Low birth weight babies are those babies who have a birth weight of less than 2500g. Premature babies are born before 38 weeks of pregnancy. Because they are born too early, they often have very low birth weights. These babies are born with low body stores of vitamin A and so they are at risk of developing vitamin A deficiency.

Infants and children with recurrent infections

Infants and children with infections are at risk of developing vitamin A deficiency because many infections, especially measles and diarrhoea increase the body's need for vitamin A to recover. Yet sick children often refuse food and so during times of illness, children tend to eat less vitamin A as well. In this way, it is easy for a sick child to become vitamin A deficient.

Infants and children with malnutrition

Most children who are malnourished are at high risk of developing vitamin A deficiency. This is because these children usually have poor diets which are not sufficient in energy, protein and many other nutrients.

Pregnant and breastfeeding women

A woman's requirements for vitamin A increase during pregnancy and lactation. If a mother consumes an adequate amount of vitamin A from her diet, her breastmilk alone will be able to provide her infant with all the vitamin A that it needs for the first 6 months of life.

An individual is at risk if the answer to any of the following questions is "yes":

Ask

- If the family cannot afford to buy vitamin A rich foods
- If the child does not eat vitamin A rich foods
- If the young infant is not breastfed
- If the child has had a recent illness in the last month such as measles or severe diarrhoea
- If the child has difficulty seeing in dim light (night blindness).

Examine

- Look at the birth weight
- Weigh the child and plot the weight on the Road-to-Health card (make sure that the child is not below the third centile and that the growth curve is increasing and not flattening)
- If the child's weight is below the third centile, exclude kwashiorkor or marasmus
- In children who are ill, exclude diarrhoea and measles
- Look for eye signs of vitamin A deficiency (see figure 2,3,4).

Treatment for identified vitamin A deficiency

Children with eye signs of vitamin A deficiency, measles, severe malnutrition, diarrhoea and pneumonia should be treated immediately with vitamin A capsules or solution.

Age	Dosage of capsule
Under 6 months	50 000 IU per day for 2 days
6 - 12 months	100 000 IU per day for 2 days
12 months and older	200 000 IU per day for 2 days

Note:

1. If there are any eye signs of vitamin A deficiency, repeat the age-specific dosage 4-6 weeks after initial treatment.
2. Caution: This dosage should be given to women of reproductive age (whether pregnant or not) ONLY where there are signs of severe xerophthalmia (eg corneal scars). Women of reproductive age with night blindness or Bitot's spots should receive daily dosages of < 10 000 IU, or weekly dosages of < 25 000 IU for at least four weeks.

How can vitamin A deficiency be prevented and eliminated?

Vitamin A interventions

A combination of interventions is usually needed to prevent and eliminate vitamin A deficiency. Measures to combat vitamin A deficiency are generally grouped into the following:

Breastfeeding protection and promotion
Breastmilk can supply all of the vitamin A that an infant needs for the first six months of life and continues to be an important source through to the age of 2 years. Encourage mothers to exclusively breastfeed for 4-6 months and to introduce vitamin A-rich complementary foods early. Advise mothers to continue breastfeeding for up to 2 years.

Food fortification
Food fortification is the addition of vitamin A to foods commonly consumed by the community. The labels of foods which are fortified, should indicate that vitamin A or any other micronutrients have been added to the food.

Supplementation
The routine provision of high-dose vitamin A supplements is an effective intervention for the improvement of vitamin A status in deficient communities. High-dose vitamin A capsules are often provided to children from 6 months onwards attending local clinics or through mass campaigns.

Toxicity: It is important that the health worker clearly records when a capsule is given to a mother or child. This is because the capsules contain a very large amount of vitamin A, which if taken too often can be harmful to the body. Side-effects are rare if the correct dosage is given. An overdose may cause headache, nausea, vomiting and diarrhoea. If toxicity is suspected, no more vitamin A capsules should be given and the child should be followed up until the symptoms subside.

Public health measures

Public health measures that aim to prevent the spread of infection (including immunisation) will help to prevent vitamin A deficiency amongst children. It is also important that children with infections are treated appropriately.

Dietary modification

Dietary modification aims to prevent vitamin A deficiency by increasing the production and consumption of foods rich in vitamin A. Community fruit and vegetable gardens can significantly increase the production of vitamin A rich foods such as mangoes, apricots, paw-paws, sweet potatoes, carrots and spinach. However, to improve vitamin A status, gardening projects must lead to increased consumption of these foods. Thus, gardening projects should be linked to nutrition education programmes. Teaching the community how to preserve these foods will help to increase the year-round availability of seasonal vitamin A rich foods. A popular method of food preservation is sun-drying. Contact the Department of Health for more information about food garden projects.

Remember: Sunlight destroys vitamin A so shield your fruit and vegetables using a black sheet to cover a well ventilated crate.

Definition of terms

Micronutrients are natural substances found in small amounts in food (e.g. vitamins and minerals) as compared to macronutrients (e.g. protein, fat and carbohydrates) which are found in larger amounts. Although the body only requires small amounts of micronutrients, they are very important in maintaining good health.

Premature babies are born before 38 weeks of pregnancy. Because they are born too early, they often have very low birth weights.

Vitamins are substances found in small amounts in food. Most vitamins cannot be made by the body and have to be taken in with food. Each vitamin has a specific function to keep the body healthy.

Vitamin A is important for keeping eyes and skin healthy. Vitamin A is found in foods in two forms, namely, as retinol or preformed vitamin A, which is the active form and found only in foods of animal origin. Vitamin A is also found as carotenoids or provitamin A which achieve vitamin A activity when converted to retinol within the body. The best sources of carotenoids are bright yellow and orange fruits and vegetables and dark green, leafy vegetables.

Vitamin A deficiency can be identified in a number of ways including specific tests which measure vitamin A in the body (e.g. blood levels of vitamin A below 20 µg/dl indicate vitamin A deficiency) as well as eye signs of vitamin A deficiency (see section 6).

Retinol Equivalents (RE) is the amount of vitamin A present in food and required by the body is measured in units called Retinol Equivalents. Vitamin A can also be measured in International Units (IU), where 1 RE = 3.33 IU.

The Recommended Dietary Allowance (RDA) specifies the amount of macro- and micronutrients that are needed daily for different age-groups to make sure that the body stays healthy.

Exclusive breastfeeding means that the baby has no other food or drink besides breastmilk - not even water. The recommended period for exclusive breastfeeding is 4-6 months of age.

Complementary foods are foods which are introduced to "complement" breastmilk. They are often called weaning foods. Most infants require complementary foods in addition to breastmilk by the age of 6 months to make certain that the child grows well.

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