# **CHS 269 Vitamins Deficiency**

A **vitamin** is an [organic compound](http://en.wikipedia.org/wiki/Organic_compound) required as a [nutrient](http://en.wikipedia.org/wiki/Nutrient) in tiny amounts by an [organism](http://en.wikipedia.org/wiki/Organism).

Until the mid-1930s, when the first commercial yeast-extract and semi-synthetic vitamin C supplement tablets were sold, vitamins were obtained solely through food intake, and changes in diet

# **Classification of vitamins :**

## ***Fat Soluble Vitamins*** *:*

## Fat-soluble vitamins are absorbed, together with fat from the intestine, into the circulation. Any disease or disorder that affects the absorption of fat could lead to a deficiency of these vitamins. Once absorbed into the circulation these vitamins are carried to the liver where they are stored.

Because they are more likely to accumulate in the body, they are more likely to lead to [hypervitaminosis](http://en.wikipedia.org/wiki/Hypervitaminosis) than are water-soluble vitamins.

## Vitamins A, D, E and K make up the fat soluble vitamins. Vitamins A, D and K are stored in the liver and vitamin E is distributed throughout the body's fatty tissues.

## ***Water Soluble Vitamins****:*

## Water-soluble vitamins, such as Vitamin C and the B vitamins are stored in the body for only a brief period of time and are then excreted by the kidneys. The one exception to this is vitamin B12, which is stored in the liver. Water-soluble vitamins need to be taken daily

## Vitamin C (ascorbic acid) and the B complex group make up the 9 water soluble vitamins. The B complex group comprises of vitamins:

## B6 (pyridoxine)

## B1 (thiamine)

## B2 (riboflavin)

B3 [Niacin](http://en.wikipedia.org/wiki/Niacin)

B5 [Pantothenic acid](http://en.wikipedia.org/wiki/Pantothenic_acid)

B7 [Biotin](http://en.wikipedia.org/wiki/Biotin)

B9 [Folic acid](http://en.wikipedia.org/wiki/Folic_acid)

## B12 (cobalamin)

For the most part, vitamins are obtained with food, but a few are obtained by other means. For example, microorganisms in the intestine — commonly known as "[gut flora](http://en.wikipedia.org/wiki/Gut_flora)" — produce vitamin K and biotin, while one form of vitamin D is synthesized in the [skin](http://en.wikipedia.org/wiki/Skin) with the help of the natural [ultraviolet](http://en.wikipedia.org/wiki/Ultraviolet) wavelength of [sunlight](http://en.wikipedia.org/wiki/Sunlight). Humans can produce some vitamins from precursors they consume. Examples include [vitamin A](http://en.wikipedia.org/wiki/Vitamin_A), produced from [beta carotene](http://en.wikipedia.org/wiki/Beta_carotene), and [niacin](http://en.wikipedia.org/wiki/Niacin), from the [amino acid](http://en.wikipedia.org/wiki/Amino_acid) [tryptophan](http://en.wikipedia.org/wiki/Tryptophan).

# **Deficiencies of vitamins are classified as either primary or secondary**.

# A **primary deficiency** occurs when an individual does not get enough of the vitamin in his food.

# A **secondary deficiency** may be due to an underlying disorder that prevents or limits the absorption or use of the vitamin, due to a “lifestyle factor”, such as smoking, excessive alcohol consumption, or the use of medications that interfere with the absorption or use of the vitamin

People who eat a varied diet are unlikely to develop a severe primary vitamin deficiency. In contrast, restrictive diets have the potential to cause prolonged vitamin deficits, which may result in often painful and potentially deadly [diseases](http://en.wikipedia.org/wiki/Disease)

**Side-effects and overdose**

In large doses, some vitamins have documented [side-effects](http://en.wikipedia.org/wiki/Hypervitaminosis) that tend to be more severe with a larger dosage. The likelihood of consuming too much of any vitamin from food is remote, but overdosing ([vitamin poisoning](http://en.wikipedia.org/wiki/Vitamin_poisoning)) from vitamin supplementation does occur.

# **Vitamin sources, uses and deficiency problems** :

## **Vitamin A (fat-soluble)**

## **Sources**: Dairy products, eggs, liver. Vit A can be converted by the body from the beta-carotene found in green vegetables, carrots and liver.

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## **RDA:** The recommended daily allowance for vitamin A is 5000 international units (IU) for adults and 8000 IU for pregnant or lactating women. Being fat-soluble, vitamin A is stored to a variable degree in the body, making it more likely to cause toxicity when taken in excess amounts

## **Uses**: Maintains the health of the epithelium and acts on the retina's dark adaptation mechanism.

Vitamin A deficiency is considered to be a major public health problem in developing countries worldwide

An estimated 78 to 253 million preschool children are affected by vitamin A deficiency, The largest number of countries affected is in Africa, whereas the largest number of children with this deficiency is in south-east Asia

Pregnant women and women of childbearing age also constitute high risk groups for vitamin A deficiency in developing countries

## **Vit A Deficiency** leads to: Keratinisation of the nasal and respiratory passage epithelium, night blindness.

## **Night blindness** and its worsened condition, **xerophthalmia**, are markers of VAD, as VAD can also lead to impaired immune function, cancer, and birth defects

Night blindness is the difficulty for the eyes to adjust to dim light. Affected individuals are unable to distinguish images in low levels of illumination. People with night blindness have poor vision in the darkness, but see normally when adequate light is present.

VAD affects vision by inhibiting the production of rhodopsin, the eye pigment responsible for sensing low light situations. Rhodopsin is found in the retina and is composed of retinal (an active form of vitamin A) and opsin (a protein). Because the body cannot create retinal in sufficient amounts, a diet low in vitamin A will lead to a decreased amount of rhodopsin in the eye, as there is inadequate retinal to bind with opsin. Night blindness results.

Night blindness caused by VAD has been associated with the loss of goblet cells in the conjunctiva, a membrane covering the outer surface of the eye. Goblet cells are responsible for secretion of mucus, and their absence results in xerophthalmia, a condition where the eyes fail to produce tears. Dead epithelial and microbial cells accumulate on the conjunctiva and form debris that can lead to infection and possibly blindness

## A close association between vitamin A deficiency and **anemia** has been shown in many nutritional surveys from around the world (Vitamin A appears to be involved in the pathogenesis of anemia through the enhancement of growth and differentiation of erythrocyte, potentiation of immunity to infection and reduction of the anemia of infection, and mobilization of iron stores from tissues)

* + Acute toxicity occurs within a few hours or days after a very large intake as a result of accidental over-ingestion or inappropriate therapy. The estimated toxic dose is about 25,000 IU/kg.
  + Chronic toxicity appears after ingestion of 25,000 IU or more daily for prolonged periods

**In acute vitamin A toxicity, a history of some or all of the following may be obtained:**

* Nausea
* Vomiting
* [Anorexia](http://emedicine.medscape.com/article/805152-overview)
* Irritability
* Drowsiness
* Altered mental status
* Abdominal pain
* Blurred vision
* Headache
* Muscle pain with weakness
* **Manifestations of chronic toxicity** 
  + Alopecia
  + Skin erythema
  + Skin desquamation
  + Brittle nails
  + Conjunctivitis
  + Petechiae
  + [Liver cirrhosis](http://emedicine.medscape.com/article/185856-overview)
  + Hepatosplenomegaly
  + Peripheral neuritis
  + Ataxia
  + Papilledema

## **Vitamin B1 (thiamine) (water-soluble):**

## **Sources**: Yeast, egg yolk, liver, wheatgerm, nuts, red meat and cereals

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## **Uses**: Carbohydrate metabolism

## **Deficiency leads to**: Fatigue, irritability, loss of appetite; severe deficiency can lead to beri-beri.

## **Vitamin B2 (riboflavin) (water-soluble) :**

## **Sources**: Dairy products, liver, vegetables, eggs, cereals, fruit, yeast

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## **Uses**: Intracellular metabolism

## **Deficiency leads to**: Painful tongue and fissures to the corners of the mouth, chapped lips untitled.bmp

## **Vitamin B12 (water-soluble) :**

## **Sources**: Liver, red meat, dairy products and fish

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## **Epidemiology**: A large study in the US found that 39 % of studied group of 3,000 had low values of B12

In the developing world the deficiency is very widespread, with significant levels of deficiency in Africa, India, and South and Central America, this is due to low intakes of animal products, particularly among the poor. The increased bacterial load due to poor sanitation, unprocessed/unsterilized food, or other sources of dietary contamination could also lead to pathogen-related malabsorption issues

B12 deficiency is even more common in the elderly. This is because B12 absorption decreases greatly in the presence of [atrophic gastritis](http://en.wikipedia.org/wiki/Atrophic_gastritis), which is common in the elderly.

B12 deficiency is common among [vegetarians](http://en.wikipedia.org/wiki/Vegetarian) and [vegans](http://en.wikipedia.org/wiki/Vegan) who do not take B12 supplements. In vegans the risk is very high because none of their natural food sources contain B12

## **Uses**: Essential for manufacturing of genetic material in cells. Involved in the production of erythrocytes

## **Deficiency leads to**: pernicious anaemia

**Causes of vit B12 def:**

* Inadequate dietary intake of vitamin B12As the vitamin B12 occurs naturally only in animal products
* Selective impaired absorption of vitamin B12 due to [intrinsic factor](http://en.wikipedia.org/wiki/Intrinsic_factor) deficiency. This may depend on loss of [gastric](http://en.wikipedia.org/wiki/Stomach) [parietal cells](http://en.wikipedia.org/wiki/Parietal_cells) in chronic [atrophic gastritis](http://en.wikipedia.org/wiki/Atrophic_gastritis) (in which case, the resulting [megaloblastic anemia](http://en.wikipedia.org/wiki/Megaloblastic_anemia) takes the name of "[pernicious anemia](http://en.wikipedia.org/wiki/Pernicious_anemia)"), or may result from wide surgical resection of stomach (for any reason), or from rare hereditary causes of impaired synthesis of intrinsic factor.
* Forms of [achlorhydria](http://en.wikipedia.org/wiki/Achlorhydria) (including that artificially induced by drugs such as [proton pump inhibitors](http://en.wikipedia.org/wiki/Proton_pump_inhibitors)) can cause B12 malabsorption from foods, since acid is needed to split B12 from food proteins and salivary binding proteins
* The [diabetes](http://en.wikipedia.org/wiki/Diabetes) medication [metformin](http://en.wikipedia.org/wiki/Metformin) may interfere with B12 dietary absorption

**Clinical symptoms:** The main syndrome of vitamin B12 deficiency is Biermer's disease ([pernicious anemia](http://en.wikipedia.org/wiki/Pernicious_anemia)). It is characterized by a triad of symptoms:

1. [Anemia](http://en.wikipedia.org/wiki/Anemia) ([megaloblastic anemia](http://en.wikipedia.org/wiki/Megaloblastic_anemia)). This is due to the inhibition of DNA synthesis .
2. Gastrointestinal symptoms: These are thought to be due to defective DNA sythesis inhibting replication in a site with a high turnover of cells.
3. Neurological symptoms: Sensory or motor deficiencies (absent reflexes, diminished vibration or soft touch sensation), or even symptoms of dementia and or other psychiatric symptoms may be present. Impaired perception of deep touch, pressure and vibration, abolishment of sense of touch, very annoying and persistent [paresthesias](http://en.wikipedia.org/wiki/Paresthesia), [Ataxia](http://en.wikipedia.org/wiki/Ataxia)

symptoms of neuronal damage may not reverse after correction of hematological abnormalities

**Masking effect of Folic acid:**

Megaloblastic anemia is an [anemia](http://en.wikipedia.org/wiki/Anemia) (of [macrocytic](http://en.wikipedia.org/wiki/Macrocytic_anemia) classification) that results from inhibition of [DNA synthesis](http://en.wikipedia.org/wiki/DNA_replication) in red blood cell production.

The defect in red cell DNA synthesis is most often due to hypovitaminosis, specifically a deficiency of [vitamin B12](http://en.wikipedia.org/wiki/Vitamin_B12) and/or [folic acid](http://en.wikipedia.org/wiki/Folic_acid). Vitamin B12 deficiency alone will not cause the syndrome in the presence of sufficient folate. Folic acid supplementation in the absence of vitamin B12 prevents this type of anemia (although other vitamin B12-specific pathologies continue).

Large amounts of [folic acid](http://en.wikipedia.org/wiki/Folic_acid) can mask the damaging effects of vitamin B12 deficiency by correcting the megaloblastic anemia caused by vitamin B12 deficiency without correcting the neurological damage that also occurs

## **Vitamin C (ascorbic acid) (water-soluble) :**

## **Sources**: Green vegetables and fruit

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## **Uses**: Essential for the maintenance of bones, teeth and gums, ligaments and blood vessels. It is also necessary for ensuring a normal immune response to infection

## **Deficiency leads to**: Scurvyuntitled.bmp

## **Vitamin D (fat-soluble) :**

## **Sources**: Fish liver oils, dairy produce. Vitamin D is formed in the skin when it is exposed to sunlight

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## **Uses**: Has a role in the absorption of calcium, which is essential for the maintenance of healthy bones

## **Deficiency leads to**: Rickets untitled.bmp

## **Vitamin E (fat-soluble) :**

## **Sources**: Pure vegetable oils; wheatgerm, wholemeal bread and cereals, egg yoke, nuts sunflower seeds

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## **Uses**: Protects tissues against damage; promotes normal growth and development; helps in normal red blood cell formation

## **Deficiency leads to**:

## May cause muscular dystrophyuntitled.bmp

## **Vitamin K (fat-soluble) :**

## **Sources**: Green vegetables

## **untitled.bmp Uses**: Used by the liver for the formation of prothrombin

## **Deficiency leads to**: Bleeding due to delayed clotting times caused by lack of clotting factors. Patients may show signs of bruising easily and have nosebleeds.

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| **Vitamins** | **Men** | **Women** |
| A | 0.7mg 0.6mg | |
| B1 | 1.0mg | 0.8mg |
| B2 | 1.3mg | 1.1mg |
| Niacin | 19mg | 15mg |
| B6 | 1.4mg | 1.2mg |
| Pantothenic acid | 5mg | 5mg |
| Folic acid | 0.2mg | 0.2mg |
| Biotin | 0.3mg | 0.1mg |
| B12 | 0.002mg | 0.002mg |
| C | 40mg | 40mg |
| D | 0.01mg | 0.01mg |
| E | 10mg | 8mg |
| K | 0.8mg | 0.06mg |