Food nutrients include carbohydrates, protein, fat, vitamins and minerals. The body needs to obtain appropriate amount of vitamins from food in order to maintain normal functions of cells and organs, and to promote growth and development. Any deficiency or overdose of vitamins could have adverse side effects.

**Functions and Categories**

- **Vitamins** have various functions that help to regulate metabolism, to prevent chronic diseases (such as heart disease and cancer), and to maintain normal appetite, mental health and immunity. Basically vitamins can be classified into two categories:
  
  1. **Fat-soluble vitamins**
     - Include vitamins A, D, E and K. They can dissolve in fats and be absorbed along with fats in the diet.
     - Excess fat-soluble vitamins are stored in the liver and will not be eliminated from the body.
  2. **Water-soluble vitamins**
     - Include vitamins B and C. They can dissolve in water.
     - Excess water-soluble vitamins are excreted through urine.

- The amount of vitamins in food is affected by the ways in which food is stored or cooked. Vitamins A and C and some vitamins B can be destroyed under strong light, so food rich in those vitamins should be stored in dim places or in the fridge. Vitamin C and some vitamins B are soluble in water and can be destroyed under heat. Therefore, we should avoid soaking the food in water or cooking the food for too long.

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**Should we take vitamin supplements?**

There are various kinds of vitamin supplements available in the market. Should we take these "tonics" to maintain good health?

We should maintain a balanced diet and should not be a picky eater. Eating according to the “Healthy Eating Food Pyramid” can provide adequate and appropriate amount of vitamins to stay healthy.

If you need to have diet control because of any illnesses, you should consult a doctor or dietitian. Never take any vitamin pill or supplement on your own.

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**Healthy Eating Food Pyramid**

*Reference: Centre for Health Protection, Department of Health*
<table>
<thead>
<tr>
<th>Vitamin</th>
<th>Function(s)</th>
<th>Food sources</th>
<th>Health effect(s) of deficiency</th>
<th>Health effect(s) of overdose</th>
</tr>
</thead>
</table>
| Vitamin A   | ● Helps in production of photo-sensitive substance (rhodopsin) in retina, which is important for night vision  
● Promotes growth and development  
● Maintains healthy skin, mucous membrane and normal function of immune system | ● Liver  
● Fish liver oil  
● Oily fish e.g. salmon, mackerel  
● Egg yolk  
● Foods containing carotenoids e.g. carrot, spinach, broccoli, papaya, tomatoes, sweet potatoes  
* β-carotene (one kind of carotenoids) can transform into vitamin A in the body | ● Night blindness, dry eyes  
● Epithelial tissue keratinization  
● Retard growth | ● Dry skin  
● Hair loss  
● Liver damage |
| Vitamin D   | ● Helps body absorb calcium and phosphorus, so as to maintain bone growth  
● Maintains the balance of calcium in blood | ● Egg yolk  
● Liver  
● Fish liver oil  
● Oily fish e.g. salmon, mackerel  
● Skins produces vitamin D when exposed to sunlight | ● Children: rickets  
● Adults: osteomalacia | ● High calcium levels in blood and urine which increase the risk of calcification of soft tissue |
| Vitamin E   | ● Acts as antioxidant which protects cell membrane from oxidative damage  
● Maintains normal function of immune system | ● Plant oil e.g. corn oil, sunflower oil  
● Nut e.g. almonds  
● Seed e.g. sunflower seeds  
● Dark green vegetables e.g. spinach, broccoli | ● Premature infants: haemolytic anaemia  
● Headache, dizziness  
● Fatigue |  |
| Vitamin K   | ● Helps blood clotting and prevent excessive bleeding | ● Dark green vegetables e.g. spinach, broccoli  
● Soya beans | ● Excessive bleeding may occur due to difficulty in blood clotting  
● Premature infants: liver damage |  |
| Folate      | ● Helps produce cells and red blood cells | ● Spinach, broccoli  
● Egg  
● Kidney beans  
● Orange, papaya | ● Megaloblastic anaemia  
● Uncommon |  |
| Vitamin B1  | ● Helps in carbohydrate metabolism and enables the body to get energy from foods  
● Maintains normal function of nervous system | ● Pork  
● Fish e.g. tuna  
● Beans e.g. black beans  
● Brown rice | ● Beriberi  
● Wernicke encephalopathy  
● Korsakoff’s psychosis |  |
| Vitamin B2  | ● Helps in protein and fat metabolism and enables the body to get energy from foods  
● Maintains the health of mucus membranes, skin, eyes and nervous system  
● Helps produce coenzymes which assist in energy production | ● Liver  
● Milk  
● Egg  
● Meat  
● Spinach, broccoli  
● Nut e.g. almond | ● Glossitis  
● Angular stomatitis  
● Cheilosis |  |
| Vitamin B3  | ● Helps in carbohydrate and fat metabolism and enables the body to get energy from food | ● Meat  
● Fish  
● Brown rice  
● Whole wheat bread  
● Seed e.g. sunflower seed, pumpkin seed | ● Pellagra  
● Uncommon | ● Flushing |
| Vitamin B6  | ● Helps in protein metabolism  
● Helps produce heme  
● Helps in nerve impulse transmission  
● Maintains normal function of immune system | ● Meat  
● Fish  
● Banana  
● Potatoes  
● Nut | ● Anaemia  
● Depression  
● Weakened immune system | ● Peripheral neuropathy |
| Vitamin B12 | ● Helps produce red blood cells  
● Maintains healthy nervous system  
● Helps in protein metabolism | ● Milk  
● Fish  
● Egg  
● Liver  
● Meat | ● Megaloblastic anaemia  
● Uncommon |  |
| Vitamin C   | ● Helps produce collagen and maintain the health of blood vessels, connective tissue and cartilage  
● Helps the absorption of non-heme iron  
● Acts as antioxidant  
● Maintains normal function of immune system | ● Citrus fruits e.g. mandarin orange, orange, grapefruit, lemon  
● Strawberry  
● Kiwi fruit  
● Guava  
● Broccoli  
● Green pepper | ● Scurvy (gum bleeding, tooth loss, fatigue, bone pain, etc.)  
● Diarrhoea |  |