

## VITAMINS

### **Aim**

Manage dietary intake of more significant vitamins including fat soluble, B and C complex vitamins for good health.

### **Terminology**

Hypervitaminosis - Too much of a vitamin, eg. Hypervitaminosis B – toxicity due to excess Vitamin B

Hypovitaminosis - Too little of a vitamin, eg Hypovitaminosis B – illness due to inadequate vitamin B.

Some of the following information will be revision for students who have completed Nutrition I.

### **FAT SOLUBLE VITAMINS**

Fat soluble vitamins include vitamins A, D, E and K. As a general rule the suffix –ol infers a fat soluble compound.

### **Vitamin A**

There are two types of vitamin A, those found in animal foods is preformed vitamin A or retinol. It is the most active form of vitamin A. In plant foods there is provitamin A, also known as carotenoid. The body must convert this and is not very efficient at doing so. Not all carotenoids are convertible into vitamin A, however many that aren't do function as anti-oxidants (lycopene for example) and are important inclusions in the diet for this reason.

Vitamin A has numerous roles in the body, not only vision. It is also important for bone growth and a role of cellular processes. The immune system requires vitamin A for proper function and the linings and membranes of the body need vitamin A to remain healthy.

Animal foods are the richest and most readily useable sources of vitamin A. Liver in particular, as well as dairy products are rich sources of vitamin A. The best plant sources include bright or dark coloured vegetables such as carrot, spinach, cantaloupe, apricot, mango, peas and capsicum.

In developed countries vitamin A deficiency is generally associated only with very strict diets or alcoholism and liver cirrhosis. It is however a serious problem in developing countries, leaving immune systems weak, and membranes of the body dry and brittle. This leads to fatal cases of measles, pneumonia and other infections.

A more common problem in developed countries is vitamin A toxicity. As a fat soluble vitamin, vitamin A can be stored in the liver; however, vitamin A is very stable and can be held for long periods. Chronic high intake can therefore result in toxicity. Increasing anecdotal evidence links high vitamin A, even in acute cases to birth defects. People who are zinc deficient are also at higher risk of toxicity as they are able to store vitamin A, but have trouble releasing it from the liver. As with all fat soluble vitamins, people with fat malabsorption disorders are at risk of vitamin A deficiency. Vegans may also be at risk of vitamin A deficiency as plant sources are not as rich as animal.

*Sources of Vitamin A (Retinol)*

FOOD	AMOUNT EATEN	AMOUNT OF VITAMIN A (Micrograms)
Cod Liver Oil	1 teaspoon	1350
Ice Cream	45gm	50
Butter	30gm	285
Calf Kidney -fried	90gm	9300
Kidney -stewed	90gm	230
Milk -whole	300ml	115
Cheese	30gm	120
Eggs	55gm	140
Apricots -fresh	90gm	210
Apricots -dried	30gm	250
Cantaloupe	90gm	290
Paw Paw	90gm	110
Tomatoes	90gm	100
Carrot -boiled	90gm	1000
Capsicum (Red)	90gm	1870
Lettuce	90gm	260
Pumpkin	90gm	480

Vitamin A supplements are rarely necessary in developed countries. They may in fact do more harm than good due to toxicity. In fact, beta-carotene supplements are strongly discouraged as they appear to increase cancer risk, but this is only in populations with adequate vitamin A intake and does not apply to developing countries. There is new research suggesting that chronic excess vitamin A can promote osteoporosis by hampering calcium absorption by inhibiting the production of vitamin D. Beta-carotene does not appear to have this effect, so eating fruits and vegetables high in provitamin A appears safe.

Symptoms of chronic hypervitaminosis A include:

- Birth defects
- Liver diseases
- Bone demineralisation
- Central nervous system disorders.

Symptoms of acute toxicity include

- Gastrointestinal upset - nausea and vomiting
- Neurological symptoms - impaired vision, headache, dizziness and muscular weakness.

Some anti-acne treatments, such as Roaccutane contain high levels of synthetic retinoids and should never be taken if pregnant or if planning pregnancy. They should be limited to the most severe cases of acne and dietary vitamin A intake may need to be adjusted accordingly.

## Vitamin D

Vitamin D comes in three isoforms, the most active being calciferol, or Vitamin D3. In the body it is enzymatically altered in the liver and kidneys to form 1,25 dihydroxyvitamin D. This active form functions as a hormone, telling the intestine to increase calcium absorption and also playing a role in the balance of calcium and phosphorus in the blood. Vitamin D is essential for proper bone and tooth mineralisation and deficiency can result in Ricketts and osteomalacia. It also has important functions within the body's individual cells.

Vitamin D is actually quite easy to get, 10-15 minutes of exposure to ultra violet radiation (sunlight) three times a week is sufficient to induce the skin to synthesise all your body's vitamin D. Darker skin is less efficient at this conversion than fair, however, strict dress codes in some countries and ethnic groups should not generally impair vitamin D synthesis but slightly longer sun exposure may be required if only hands, feet and face are exposed. Food sources are generally products fortified with the vitamin, such as milk, margarine, bread and cereals. The amount of fortification will vary from country to country. The richest natural sources are fatty fish, such as salmon, mackerel and tuna. Eggs also have a small amount of vitamin D.

### *Sources of Vitamin D*

FOOD	AMOUNT EATEN	AMOUNT OF VITAMIN D (Micrograms)
Cod liver oil	25ml	34µg
Tuna	100g	11-20.5µg
Cooked salmon	100gm	9µg
Cooked mackerel	100gm	8.5µg
Milk, whole	250ml	2.5µg
Eggs (whole or just yolk)	1	0.5-0.6µg
Beef liver	100g	0.4µg

Vitamin D deficiency is most commonly seen in people with kidney diseases, liver diseases or digestive illnesses such as Celiac disease, irritable bowel syndrome and acute diarrhoea. Kidney and liver diseases can hamper conversion of dietary vitamin D to its active form while bowel disorders can limit absorption of the vitamin in the first place. Prolonging exclusive breastfeeding (breast milk only and no foods) is one of the most common causes of vitamin D deficiency and Ricketts in infants and toddlers. Older people are also at greater risk of vitamin D deficiency as they are less efficient at synthesising and converting vitamin D. In colder climates with less sunlight hours, exposure to sun is less likely to supply vitamin D in sufficient quantity. As with all fat soluble vitamins, people with fat malabsorption are at risk of deficiency.

While research is still ongoing, it is apparent that osteoporosis, a condition traditionally attributed solely to calcium deficiency, is likely also related to vitamin D deficiency. Post menopausal women are at particular risk of osteoporosis and calcium and vitamin D intake should be closely monitored. Other areas of interest include the possibility of reduced cancer risk, impaired vitamin D absorption with steroidal anti-inflammatory treatments and reduced vitamin D responsiveness. All of these areas are in the early stages of research and remain possible, but unconfirmed.

Symptoms of toxicity include:

- Gastrointestinal upset - nausea and vomiting, constipation and decreased appetite with weight loss
- Neurological symptoms - lethargy, muscular weakness and confusion.

Toxicity is almost always a case of over supplementation, and not diet or excessive sun exposure. Infants should not receive more than 25µg daily; all others can tolerate, but should not exceed 50µg daily.

### **Vitamin E**

There are actually 8 different vitamins in the vitamin E family, referred to as tocopherols. Alpha-tocopherol is the most active, but all have some degree of potency in humans. Vitamin E is best known as an antioxidant, and in this role may help inhibit cellular damage that can set off the chain of events that result in tumour development. It also appears to function in the immune system, as well as within individual cells.

The best sources of vitamin E are plant oils (vegetable and nut). Less rich sources include green vegetables. Vegetarians and vegans tend to have good vitamin E intake, but diets high in meats and animal fats can often be lacking.

#### *Sources of Vitamin E (Tocopherols)*

FOOD	AMOUNT EATEN	AMOUNT OF Vitamin E (milligrams)
Sunflower Oil	100gm	48.7
Safflower Oil	100gm	38.7
Palm Oil	100gm	25.9
Polyunsaturated Margarine	100gm	25
Soybean Oil	100gm	10.1
Olive Oil	100gm	5.1
Hazelnuts	100gm	21
Almonds	100gm	20
Peanuts	100gm	5.6
Tuna -canned	100gm	6.3
Sweet Potato cooked	100gm	4
Mayonnaise	100gm	4.9

Vitamin E deficiency is quite rare and most likely secondary to an illness, such as a genetic enzyme deficiency and, more commonly, in babies born very prematurely at very low weights, under 2kg. Symptoms are predominantly neurological; muscle weakness, nerve degeneration and poor nervous system function in general. Muscle fatigue and blindness can also occur. A person who is zinc deficient is also at increased risk of hypovitaminosis E as are people with fat malabsorption disorders.

Vitamin E toxicity is not as widely studied or understood as other vitamin toxicities. Symptoms may include bleeding problems as blood coagulation is impaired.

The TUL for vitamin E should not be exceeded. People with clotting problems, or who are on medications to improve clotting, or limit clotting should seek advice on their vitamin E intake.

Vitamin E may reduce the risk of atherosclerosis and coronary heart disease and, as an antioxidant may also reduce risk of cancer development. Vitamin E also appears to aid in the prevention of cataracts. Like all research on this vitamin, these are still inconclusive.

**Vitamin K**

Vitamin K is also known as phylloquinone. It is essential for blood clotting (in contrast to vitamin E which thins the blood). Vitamin K is also required for good bone and kidney health and function. The human body cannot synthesise its own Vitamin K. However, about half a person’s daily requirement of vitamin K can be provided by the bacteria that live in the bowel.

Vitamin K may be found in high quantity in green leafy vegetables, including spinach, lettuce and cabbage. Other rich sources include broccoli and cauliflower, soy beans and wheat bran. Beef liver is the best animal source.

*Sources of Vitamin K*

FOOD	AMOUNT EATEN	AMOUNT OF Vitamin K (micrograms)
Kale	1 cup	547µg
Broccoli	1 cup	420µg
Spinach	1 cup	120µg
Beef	100g	104µg
Soybean oil	25ml	26.µg
Eggs	1	25µg
Strawberries	1 cup	23µg
Canola oil	25ml	19.7µg
Oats	30g	18µg
Milk	225ml	10µg
Olive oil	25ml	6.6µg

Vitamin K deficiency results in delayed clotting time, and people can bruise easily, suffer frequent bleeds, heavy menstrual flow and blood in the urine or faeces. Vitamin K deficiency severe enough to cause recognisable symptoms is rare, however most people do not get the RDI. The fact that vitamin K can be stored in the body helps limit deficiency. People with clotting disorders need to limit vitamin K intake and keep it constant, following their doctor’s advice and guidelines. People with liver disease are at risk of deficiency. Infants fed breast milk only for extended periods are at risk of vitamin K deficiency also. While vitamin K injections are given prophylactically soon after birth in many countries, to prevent a hemorrhagic condition, this is controversial as the risk of the developing the condition is typically low.

Vitamin K toxicity is not common, but is a concern for people with clotting disorders. Some forms of vitamin K can, at high levels, compromise anti-oxidants in the body and may also cause liver damage and haemolytic anaemia. Vitamin K may be important in the prevention of osteoporosis and also in the prevention of disease progression in atherosclerosis and coronary heart disease.

### **FAT SOLUBLE VITAMINS AND MALABSORPTION**

In order to get sufficient quantities of the fat soluble vitamins one must be ingesting and properly absorbing dietary fat. Any disease which affects fat absorption will also compromise absorption of vitamins A, D, E and K. Fat malabsorption is associated with Celiac disease, Crohn's disease, Cystic Fibrosis, liver disease and cirrhosis and some pancreatic conditions. Tumours affecting the liver or bowels, or surgical procedures to, or removing parts of the lower digestive tract can also significantly impair fat and fat soluble vitamin absorption.

### **WATER SOLUBLE VITAMINS**

#### **Vitamin C**

Vitamin C is also known as ascorbic acid and cannot be synthesised by the human body. It has a range of crucial functions in the body, in the formation of connective tissue, neurological signalling, energy production, and immune system function. Vitamin C is also a powerful antioxidant.

Vitamin C is relatively fragile, being degraded by air, heat and also leeching into cooking water. However, orange and red fruit and vegetables are all rich sources, with raw red capsicum being a particularly good source. Broccoli and potato also contain vitamin C.

Vitamin C deficiency is not common in developed countries, but still occurs, and can be fatal in developing regions. The deficiency disease, known as scurvy causes bleeding problems, hair and tooth loss and joint pain as connective tissue breaks down. People on very restricted diets are at risk of scurvy.

Vitamin C may play a role in reducing a person's risk of cardiovascular disease and stroke as well as decreasing the risk of cataracts. High vitamin C intake also appears to assist in people with lead toxicity. People with these conditions, as well as hypertension, atherosclerosis cancer and diabetes may benefit from increasing their vitamin C intake as a part of a standard medical treatment program. Women on birth control pills and those on blood thinning medication are at increased risk of deficiency. However, those on blood thinners should not exceed 1000mg daily. Vitamin C is well known to reduce the severity and duration of colds when taken in high doses when symptoms first appear.

### Sources of Vitamin C (Ascorbic Acid)

FOOD	AMOUNT EATEN	AMOUNT OF VITAMIN C (mg)
Apricots -fresh	90gm (2 small)	10
Apple (average)	90gm (1 medium)	10-15
Blackberries	90gm (half a cup)	20
Cantaloupe	90gm (small slice)	27
Orange	90gm (1 medium)	50
Guava	90gm (half a cup)	270
Paw Paw	90gm (half a cup)	55
Strawberries	90gm (half a cup)	50
Tomatoes	90gm (one medium)	20
Potato -fresh & boiled	90gm	25
Potato -baked	90gm	10
Peas -boiled	90gm	15
Cabbage -boiled	90gm	36
Carrots -boiled	90gm	3
Cauliflower -boiled	90gm	44

Vitamin C toxicity can occur and care should be taken with people who suffer lead toxicity and those who are pregnant, as well as infants. However, tolerable limits are very high, with adults able to take 2 grams a day with no apparent ill effects.

### **B Group Vitamins**

B vitamins are a large family of water soluble vitamins.

- **B1 - thiamine**

Vitamin B1 is involved in processes ranging from the passage of ions in the cells of muscular and nervous tissues, the production of energy from sugars and acid digestion of food. It is not stored in the body and must be obtained from the diet. Refinement and milling processes strip the B1 from grains, but such products are generally fortified to replace it.

B1 can be sourced from red meat, legumes, dairy, nuts and oranges as well as wholegrain. Vitamin B1 deficiency results in a condition known as Beri Beri. People at risk of deficiency include alcoholics, recovering alcoholics, those taking antacids frequently; those on barbiturate medications, some types of diuretic drugs may also increase risk of B1 deficiency. Smokers are at risk of deficiency and may benefit from additional B1 intake. Women on birth control pills are also at higher risk of deficiency. Betel nut and diuretic herbs may also reduce thiamine levels.

Toxicity is not established for B1 and no upper daily limit has been set. Older patients may benefit from a prophylactic increase in B1 consumption. Under medical supervision, thiamine can be used to treat a variety of metabolic disorders.

*Sources of Vitamin B1 (THIAMIN)*

FOOD	AMOUNT EATEN	AMOUNT OF B1 (Micrograms)
Pork-boneless, average fat, uncooked	90gm	510
Vegemite (Yeast spread)	3gm	300
Cornflakes	30gm	275
Liver -fried	90gm	230
Cooked Oatmeal	240gm	180
Milk	300ml	105
Vegetables (average mix)	90gm	100
Roast lamb	90gm	100
Eggs	55gm	50
Bread	25gm	30-88
Fish	120gm	60
Rump beef grilled medium	90gm	60
Cooked rice	240gm	56
Fruit -raw	90gm	35
Cheese -cheddar	30gm	10

- B2 (Riboflavin)

B2 is involved in a number of functions, from cellular health, immune system and adrenal gland functioning, activation of B6 and creation of niacin and also for the manufacture of red blood cells.

Highest amounts of B2 are found in organ meats. However, while B2 toxicity is not reported, organ meats are high in both cholesterol and vitamin A, both of which can be very harmful in large quantities. For this reason, other food sources should be included to obtain dietary requirement of B2.

Professional athletes, those regularly performing strenuous exercise, those with high protein intake, taking birth control pills, regular antibiotics and alcohol drinkers all require additional B2 intake. During periods of rapid growth extra vitamin B2 is also very important. While the lack of storage and rapid excretion mean toxicity is almost unheard of, deficiency does occur. Symptoms include:

- Dermatitis
- Hair loss
- Weak nails
- Dizziness
- Insomnia
- Photosensitivity
- Digestive problems
- Growth retardation



### Sources of Vitamin B2

FOOD	AMOUNT EATEN	AMOUNT OF RIBOFLAVIN (Micrograms)
Liver -fried	90gm	3260µg
Kidney -stewed	60gm	2640µg
Milk	300ml	500µg
Cornflakes -enriched	30gm	400µg
Meat (average -cooked)	90gm	170µg
Eggs	55gm	150µg
Cheese -cheddar	30gm	140µg
Fish	120gm	110µg
Vegetables (average mix)	90gm	70µg
Oatmeal -cooked	240gm	30µg
Fruit (average mix)	90gm	30µg
Bread -white	25gm	20µg

- B3 - Niacin

Niacin may also be referred to as nicotinic acid or nicotinamide which is the active form of niacin utilised by the body. It functions in the formation of a crucial enzyme co-factor, NAD which catalyses a variety of reactions in cells.

Grains (with the exception of corn and to a lesser extent sorghum) are high in niacin. So, cereals and wholegrain foods are typically good sources. Yeast, meat, poultry, pink or red fleshed fish, particularly tuna are the best sources next to fortified grains. Lentils, nuts and pasta also provide smaller amounts.

Severe niacin deficiency results in a condition known as pellagra. Symptoms are gastrointestinal and neurological and skin disorders also occur. Pellegra is characterised by the four D's, that is, dermatitis, diarrhoea, dementia, death. It is most common in areas where corn is the staple grain in the diet. Niacin can be made in the body, from tryptophan, however this is compromised if tryptophan or B6 levels are low.

Nicotinic acid supplementation can protect the cardiovascular system by reducing cholesterol levels while niacin may also slow the progression of HIV infection to AIDS. Toxicity is not a concern with food-borne niacin, but commercial preparations have had adverse effects in high dose in some people.

Nicotinic acid is generally available only on prescription as side-effects can occur with high dose. These include general gastrointestinal upset, flushing and itching as well as more serious side-effects including liver damage (often people become jaundiced, with a yellowing complexion and impaired glucose tolerance leading to symptoms of type II diabetes. Nicotinamide is not as likely to cause toxicity, but if it does, symptoms are predominantly gastrointestinal. Liver problems may also occur. Care should be taken with B3 supplements in type II diabetics as it can cause a worsening of symptoms.

### Sources of Niacin

FOOD	AMOUNT EATEN	AMOUNT OF NIACIN (milligrams)
Bran (eg. All Bran)	100gm	49
Coffee	100gm	22
Peanuts	100gm	16
Liver -lamb (cooked)	100gm	15.2
Tuna -canned	100gm	12.9
Chicken Liver	100gm	10.5
Cereals (eg.Cornflakes)	100gm	9.2
Salmon -smoked	100gm	8.8
Turkey	100gm	8.5
Chicken	100gm	8
Sardines -canned	100gm	8.2
Veal fillet	100gm	7
Rump Steak	100gm	6.4

- B6 - pyridoxine

Vitamin B6 is required as a cofactor for 100s of enzymes and also for normal immune and nervous system function, red blood cell function and niacin use. It cannot be made in the human body and must be obtained in the diet. Vitamin B6 is necessary for the formation of haemoglobin, the protein required to carry oxygen in the blood. Deficiency therefore results in anaemia. For people who are on a restricted calorie diet vitamin B6 is needed to enable conversion of stored nutrients into energy.

B6 can be obtained from poultry and meat, fish, seeds, fruit and vegetables. Potato and banana are particularly rich sources. Deficiency is rare and symptoms don't appear until the deficiency is severe. Aside from anaemia, other symptoms can be vague and are generally due to a combination of hypovitaminoses. Some more specific symptoms include depression, tongue inflammation and ulcers in the mouth. People who have maintained a poor diet for an extended period should consider extra vitamin B6 to stave off deficiency, even if symptoms aren't apparent. Alcoholics are at risk of deficiency as alcohol destroys b-group vitamins and children taking some asthma medications may need additional vitamin B6 also. Supplementation may also be useful in treating chemical depression, as B6 is required for serotonin and dopamine synthesis.

Vitamin B6 toxicity can result in nerve damage that is most commonly apparent in the limbs. The damage can be reversible and staying under the tolerable limit of 100mg per day for adults should prevent toxicity. B6 may be useful to alleviate morning sickness, PMS and carpal tunnel syndrome.

### Sources of Vitamin B6

FOOD	AMOUNT EATEN	AMOUNT OF B6 (Milligrams)
Unprocessed Bran	100gm	1.38
Potato Chips	100gm	0.89
All Bran(Breakfast Cereal)	100gm	0.83
Soya Flour	100gm	0.68
Walnuts	100gm	0.55
Banana	100gm	0.51
Peanut Butter	100gm	0.5
Wholemeal Flour	100gm	0.5
Liver	100gm	0.49
Sardines -canned	100gm	0.48
Tuna -canned	100gm	0.44
Avocado	100gm	0.42
White Fish	100gm	0.38
Lean Meat	100gm	0.33
French Fries	100gm	0.39

- B9 - Folate

Folate is naturally occurring vitamin B9, while synthetic B9 is folic acid. B9 is very important in the generation of new cells. It is required to make and help protect a cell's genetic material. It is therefore very important in foetal development and pregnancy.

Folate can mask B12 deficiency. While it can help correct anaemia, underlying nervous degeneration is not remedied.

Fortified cereal and grain products are some of the richest sources of folate. Other sources include the dark green leafy vegetables, legumes, asparagus, rice, peas, broccoli, avocado, nuts and some fruits. Increased folate is required in people who are pregnant or breastfeeding, people with malabsorption disorders, those on dialysis or who have liver disease or anaemia. Alcoholics will also need extra folate. Many medications can affect folate absorption, function or utilisation including metformin, some anti-inflammatories, some anti-convulsants, barbituates and cancer drugs. Type II diabetics often take medications that affect folate.

Folate deficiency is known to cause birth defects, particularly related to spinal cord development. It can also result in failure to thrive in babies and children, anaemia and more vague gastrointestinal symptoms along with palpitations and moodiness. It may also cause behavioural disorders and increase the risk of cardiovascular disease. B9 supplementation should not exceed 1000µg a day, to ensure B12 deficiency, if it exists can be identified.

As with most water soluble vitamins, toxicity risk is very low and high intake has only been associated with the masking of B12 deficiency.

### Sources of Folate

FOOD	AMOUNT EATEN	AMOUNT OF FOLATE (Micrograms)
Breakfast cereal	1 cup	200µg
Lentils	½ cup	180µg
Collard greens	1 cup	180µg
Chickpeas, pinto beans	½ cup	145µg
Spinach	½ cup	130µg
Cooked pasta	½ cup	100-120µg
Papaya	1 medium	115µg
Asparagus	5 spears	110µg
Corn cob	1 ear	55µg
Soybeans	½ cup	45µg
Peanuts	½ cup	40µg
Egg	1	25µg
Banana	1 medium	20µg
Tinned salmon	75g	17µg
Milk	250ml	10-15µg

- B12

Vitamin B12 is important for nerve cell and red blood cell function. It is also important for the genetic health and stability of cells. B12 is rapidly absorbed after digestion in the stomach and unlike most other water soluble vitamins; it can be stored in the body.

Sources of B12 are animal products; both meats, poultry and fish, as well as dairy and eggs. Fortified products and supplements are the only source for vegans and others who don't eat animal products. Even lacto and lacto-ovo vegetarians will have trouble getting B12 as the levels in dairy and eggs are significantly lower than in meat and fish.

While B12 deficiency is rare, some more common subpopulations are at risk, particularly vegans and the elderly. People suffering pernicious anaemia are also at increased risk of B12 deficiency as they are not as able to absorb the vitamin. Vitamin B12 deficiency can cause megaloblastic anaemia and is in turn used in treatment of the condition. People with Lebers disease can suffer worsening symptoms with vitamin B12. Symptoms of deficiency include cognitive impairment, followed by anaemia and dementia if left untreated. People with gastrointestinal disorders may also have trouble absorbing B12.

People suffering bacterial overload in the bowel may have reduced vitamin B12 uptake and people taking metformin may also require vitamin B12 supplementation. Breastfeeding mothers must ensure they are getting enough B12, as babies can develop deficiency rapidly and it can lead to irreparable neurological damage.

B12 toxicity is not established and there is no set upper tolerable limit.

### Sources of Vitamin B12

FOOD	AMOUNT EATEN	AMOUNT OF VITAMIN B12 (micrograms)
Liver (Lambs)	100gms	81µg
Kidneys (Lamb)	100gms	79µg
Liver (Chicken)	100gms	49µg
Sardines (Canned)	100gms	28µg
Oysters	100gms	15µg
Liverwurst	100gms	8µg
Brains (Lambs)	100gms	8µg
Milk -skim/powdered	100gms	3µg
Turkey (no skin)	100gms	3µg
Fish (white)	100gms	1-3µg
Lean beef or mutton	100gms	1-2µg
Eggs	100gms	1.7µg
Cheese -Cheddar	100gms	1.5µg

### WATER SOLUBLE VITAMINS - DEFICIENCIES

All of the water soluble vitamins are readily excreted from the body in the urine, except vitamins B6 and B12. So, unlike the fat soluble vitamins, there is little to no store of the water soluble vitamins. This makes regular daily intake very important and is also the reason why hypervitaminosis is rare with the water soluble vitamins, but hypovitaminosis is common. It is also harder to get a good intake of the water soluble vitamins as they readily leech out of foods and into cooking liquids, and they are generally more fragile (heat labile, degraded in light/air) than fat soluble vitamins.

### VITAMINS AND THE LIVER

The liver stores vitamins in the body. Damage to the liver therefore compromises the body's ability to maintain fat soluble vitamins B6 and B12 stores. Conversely, excess consumption of vitamins or minerals can result in toxic build up in the liver which compromises liver function and can cause physical damage to the liver cells and tissue. This then further compromises the ability of the body to store and manage nutrients.

Heavy consumption of alcohol taxes the liver. This is because the liver is the organ that metabolises all the alcohol we consume. Damage to the liver due to alcoholism can impair the storage ability for fat soluble vitamins. It can also deplete vitamin B, necessitating higher intake. Vitamin C intake should also be increased because of the antioxidant function it has. Because alcohol impairs fat absorption, vitamins A, D, E and K are not efficiently absorbed from foods ingested while drinking.

## VITAMINS AND THE BOWEL

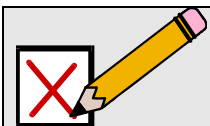
Vitamins B2, B12 and K can all be produced in small quantities by the bacteria that colonise the human bowel. People who have any sort of bowel condition, particularly those that deplete bacterial populations (chronic antibiotic treatment has this effect) will need to increase their intake of B2, B12 and vitamin K to compensate.

## VITAMINS, CANCER AND OTHER CHRONIC DISEASES

There is a lot of research and hype within the health industry about the role of vitamins in cancer and their use to prevent or treat cancer. While there are some findings of interest, in general, the best course of action is simply to maintain a healthy, balanced diet. In so doing, vitamin levels will be optimal, deficiency and toxicity which may link to disease will be avoided and you have the best chance of avoiding, or recovering better from disease. A single vitamin supplement on its own will not cure a cancer, nor prevent a specific type of cancer from occurring. However, adequate intake of vitamins can reduce risk of certain cancers and diseases.

Some evidence exists for the following (by no means conclusive in most cases):

- Excess retinol - Osteoporosis, birth defects, liver anomalies
- Excess beta carotene -Worsening of lung cancers, may increase risk of cancer in smokers
- Deficient Vitamin D - Well established that this results in Rickett's in children, osteomalacia in adults. Increases risk of osteoporosis.
- High Vitamin D - Reduced risk of cancer, particularly colon
- High Vitamin E- Appears to be cardio-protective, may reduce risk of some cancers (prostate, colon, breast) due to antioxidant action
- Deficient Vitamin B6 -May increase risk of neurologic conditions including Parkinson's disease
- High Vitamin B6 - May be cardio-protective
- High Vitamin B12 - May be cardio-protective
- High Vitamin C - May reduce risk of some cancers, and stroke. May also be cardio-protective. Most effects attributed to its antioxidant function.



### SELF ASSESSMENT

Perform the self assessment test titled 'Test 4.1'

If you answer incorrectly, review the notes and try the test again.

**SET TASK**

Find up to three people to work with. Ask them to keep for you a food diary for between 3 days and 1 week. Have them note all food and drink as well as dietary supplements consumed over this time. Get an estimate of portion sizes and how food is prepared.

For each person, determine whether their weekly vitamin intake is adequate.

With your findings, interview each person briefly. Discuss with them symptoms one would expect with vitamin deficiencies/toxicities you have identified in their diet. Do they have these symptoms? Where they aware of these problems in their diet? How could they improve their vitamin intake.

**ASSIGNMENT**

Download and do the assignment called 'Lesson 4 Assignment'.