

# VITAMIN

# B<sub>12</sub>

## *The Exclusive Vitamin*

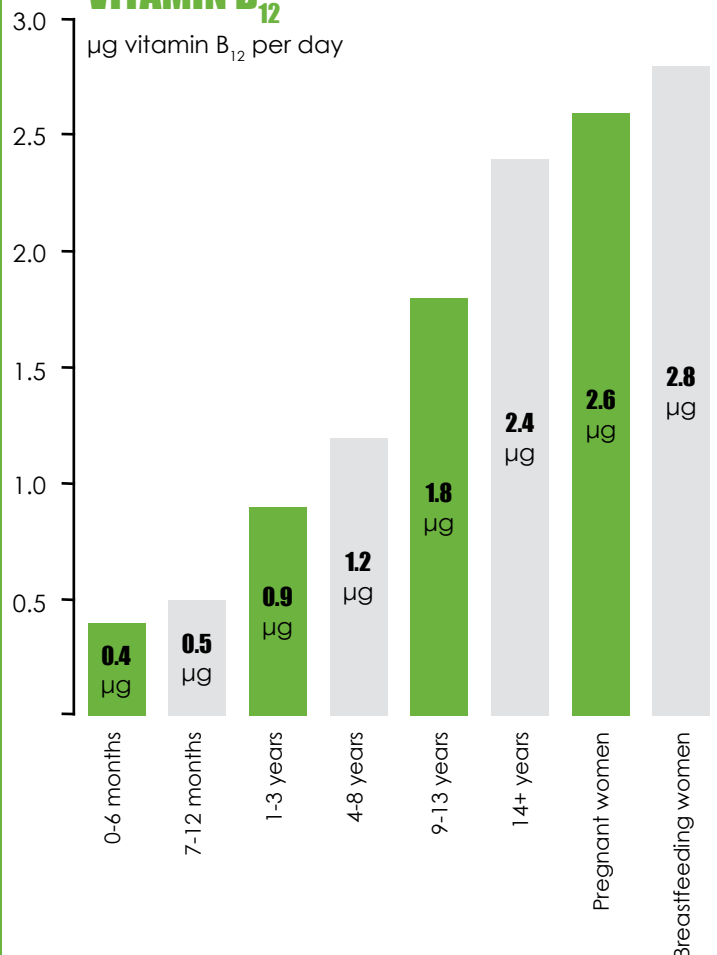


Vitamin B<sub>12</sub> is found naturally in all foods of animal origin and a few foods that have been fortified. Symptoms of vitamin B<sub>12</sub> deficiency can take several years to develop as liver stores may be large and vitamin B<sub>12</sub> is recycled internally. In older people, however, the ability to absorb vitamin B<sub>12</sub> from the gut may be reduced by lack of intrinsic factor making onset more sudden. Dietary adequacy is achievable for most healthy New Zealanders who adopt a balanced eating pattern including lean red meat and dairy products.

## WHAT DOES VITAMIN B<sub>12</sub> DO?

Vitamin B<sub>12</sub> is involved in the maintenance of the nervous system, through the production of fatty acids in myelin. It is necessary for the rapid synthesis of DNA during cell division. This is particularly important where cells are dividing rapidly, such as bone marrow tissues responsible for red blood cell formation. In vitamin B<sub>12</sub> deficiency, DNA production is disrupted and abnormal cells called 'megaloblasts' occur, resulting in anaemia. In addition, low levels of vitamin B<sub>12</sub> play a role in manifesting metabolic risk factors, such as fat accumulation, reduced skeletal muscle and increasing insulin resistance.

## RECOMMENDED DIETARY INTAKE FOR VITAMIN B<sub>12</sub>



Source: NHMRC, 2006

## BIOCHEMICAL INDICATORS OF VITAMIN B<sub>12</sub> STATUS

- **Serum vitamin B<sub>12</sub>** levels reflect both intake and stores. <150pmol/L is the traditional clinical deficiency cut-off point, although this may vary between laboratories. Low concentrations will, however, represent a long-term deficiency or chronic low dietary intake. 150pmol/L – 250pmol/L is defined as subclinical deficiency<sup>2</sup>. Serum vitamin B<sub>12</sub> levels may not be a reliable indicator of true vitamin B<sub>12</sub> status in those taking seaweed or spirulina supplements. These products contain inactive vitamin B<sub>12</sub> analogues, which may give a false, inflated status and even interfere with vitamin B<sub>12</sub> function.
- **Raised homocysteine** levels, above 15µmol/L, indicate clinical vitamin B<sub>12</sub> deficiency. However, raised levels may also be seen in folate and vitamin B<sub>6</sub> deficiencies, alcohol abuse<sup>3</sup> and renal insufficiency<sup>4</sup>, so these should also be considered.
- **Serum methylmalonic acid (sMMA)** levels >0.26µmol/l is a sensitive and more specific indicator of vitamin B<sub>12</sub> deficiency, although raised levels can also occur in renal insufficiency<sup>5</sup> and during antibiotic use<sup>6</sup>.

## ABSORPTION ABNORMALITIES

Intrinsic factor (IF) is produced in the stomach, and is required to release vitamin B<sub>12</sub> from protein foods, allowing it to be absorbed in the terminal ileum. The following conditions interfere with this mechanism:

- Pernicious anaemia – in which antibodies to IF are produced, preventing absorption.
- Gastric surgery - can lead to reduced or ineffective IF production.
- Disorders or surgery of the small intestine, e.g. Crohn's disease – which can interfere with the absorption of the vitamin B<sub>12</sub>/IF complex.
- Long term medication use – proton pump inhibitors and H<sub>2</sub>-receptor antagonists, such as omeprazole and cimetidine, reduce gastric acid production and hence vitamin B<sub>12</sub> absorption. Metformin, used to treat diabetes, prevents the absorption of the vitamin B<sub>12</sub>/IF complex.

Where malabsorption exists, increasing the intake of foods either rich or fortified in vitamin B<sub>12</sub> is unlikely to be effective; supplements or intramuscular injections may be required.

## POPULATION GROUPS AT RISK OF VITAMIN B<sub>12</sub> DEFICIENCY

Many New Zealanders have an adequate vitamin B<sub>12</sub> intake, although the last adult nutrition survey showed over 22% young women had inadequate intake. Certain groups may also be at greater risk of vitamin B<sub>12</sub> deficiency. This may be due to an inadequate intake or a reduced ability to absorb vitamin B<sub>12</sub>.

### VEGETARIANS, PARTICULARLY VEGANS

Vitamin B<sub>12</sub> is only found in fermented foods and foods of animal origin, so those following a strict vegetarian or vegan diet are at greater risk of vitamin B<sub>12</sub> deficiency and are recommended to take a supplement<sup>7,1</sup>.

### PREGNANT AND BREASTFEEDING WOMEN

Recommended intakes for vitamin B<sub>12</sub> are higher during pregnancy and while breastfeeding to allow for the needs of both mother and foetus/infant (NHMRC, 2006). Women following a low animal food diet are recommended to eat foods fortified with vitamin B<sub>12</sub> or take a vitamin B<sub>12</sub> supplement<sup>8</sup>.

### INFANTS

Studies have shown infants born with vitamin B<sub>12</sub> deficiency to vegan mothers. This is due to inadequate body stores. Normal infant body stores have been estimated to last around eight months<sup>9</sup>. Infants of vegan mothers continue at risk if breastfed by mothers not taking vitamin B<sub>12</sub> supplements. One study showed a 14 month old boy breastfed exclusively until 9 months of age had severe vitamin B<sub>12</sub> deficiency caused by his mother's strict vegan diet. Supplemental B<sub>12</sub> led to a rapid improvement in haematological and neurological symptoms, although cognitive and language development remained seriously delayed at the age of two years<sup>9</sup>. Vegan infants who are not breastfed, should be given a suitable soy-based infant formula until two years of age. Complementary foods should include vitamin B<sub>12</sub>-fortified foods each day. If not, a supplement will be required<sup>10</sup>.

### OLDER PEOPLE

A study using a nationally-representative sample of older New Zealanders, aged over 65 years, showed 12% were vitamin B<sub>12</sub> deficient with another 28% marginally deficient. Atrophic gastritis, common amongst older people, was found in 33% of those with vitamin B<sub>12</sub> deficiency<sup>11</sup>. This can impair vitamin B<sub>12</sub> absorption due to reduced gastric acid and pepsin secretion. But this didn't fully explain the prevalence of vitamin B<sub>12</sub> deficiency. Inadequate intakes have also been suggested<sup>12</sup>. The Ministry of Health recommends all older people have at least one serving a day of lean meat, chicken, seafood or eggs at least three servings of milk or dairy products each day<sup>13</sup>.

## VITAMIN B<sub>12</sub> DEFICIENCY

Inadequate dietary intake of vitamin B<sub>12</sub> may not be detected at first as liver stores can be substantial. Symptoms of deficiency may include:

- tiredness
- pale skin
- shortness of breath
- anorexia
- weight loss
- longer term, tingling in the hands and feet, a sore tongue and possibly memory loss, confusion and depression.

These are largely due to the two major syndromes resulting from vitamin B<sub>12</sub> deficiency – megaloblastic anaemia and neuropathy. In older adults, dementia may also occur in those with low plasma B<sub>12</sub> concentrations. A dietary balance of vitamins B<sub>12</sub>, B<sub>6</sub> and folate is required for the conversion of methionine to cysteine, via homocysteine at all ages. Low levels of vitamin B<sub>12</sub>, combined with high folate renders folate unavailable and homocysteine accumulation cannot be prevented. Elevated homocysteine is a strong, independent risk factor for dementia, cognitive decline and cardiovascular disease.

## WHERE IS IT?

Vitamin B<sub>12</sub> is only found naturally in foods of animal origin, i.e. meat, fish, eggs, milk and dairy products. Vitamin B<sub>12</sub> is not found in any plant foods including grains, fruit and vegetables. Most New Zealand adults and children obtain the majority of their vitamin B<sub>12</sub> from these foods, with beef the most common source for children and second only to dairy products in adults<sup>14,15</sup>. Some soy products and a few yeast extracts have vitamin B<sub>12</sub> added.

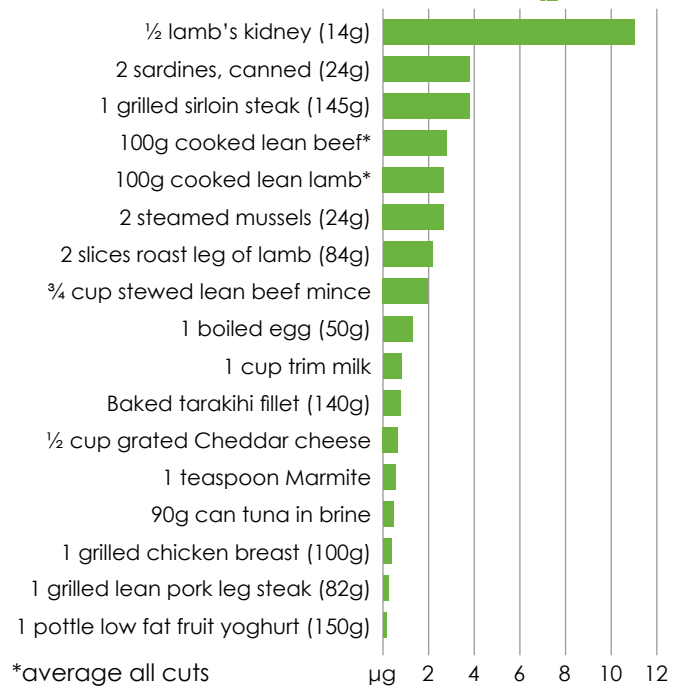
## FOOD AND NUTRITION GUIDELINES

The Ministry of Health Food and Nutrition Guidelines recommend the inclusion of vitamin B<sub>12</sub> for all New Zealanders. For example, the adult guidelines state: "Meat, seafood, milk and milk products, egg and liver are rich sources of vitamin B<sub>12</sub>. The consumption of foods rich in vitamin B<sub>12</sub> should be encouraged"<sup>16</sup>.

## VEGETARIANS/VEGANS

Dairy products, eggs and/or foods with added vitamin B<sub>12</sub> should be eaten every day. Foods with added vitamin B<sub>12</sub> include some fortified soy products and a few yeast extracts. Strict vegetarians or vegans, should take a vitamin B<sub>12</sub> supplement. This is particularly important when breastfeeding, to ensure adequate infant stores. Spirulina and other seaweed products are not considered suitable sources of vitamin B<sub>12</sub>.

## DIETARY SOURCES OF VITAMIN B<sub>12</sub>



## EVERYDAY MEALS PROVIDING VITAMIN B<sub>12</sub>

Meal	µg VITAMIN B <sub>12</sub>
<b>BREAKFAST</b>	
• Bowl of cereal(45g) with 1 cup trim milk	0.8
• 2 slices toast with 2 teaspoons Marmite and a boiled egg	2.7
<b>LUNCH</b>	
• Filled roll with 100g lean beef and salad	2.6
• 2 canned sardines on toast	3.4
• Pita filled with 100g lean lamb, lettuce, tomato and avocado	2.4
• Medium jacket potato filled with 3/4 cup beef chilli con carne, topped with 1/2 cup grated cheese and served with salad	1.3
<b>Tip: Add some chopped kidneys or grated lamb's fry* to chilli con carne for an extra vitamin B<sub>12</sub> boost. *Pregnant women should avoid eating more than 100g of lamb's fry/liver a week.</b>	
<b>DINNER</b>	
• Steak and kidney pie (136g piece) and vegetables	10.9
• Lean lamb leg steak (120g) stir-fry with vegetables and noodles	2.7
• Pizza topped with 90g tinned tuna and 1 cup cheese	2.0
• Grilled sirloin steak with wedges and salad	3.5
<b>Tip: Desserts, including dairy products, such as fresh fruit and yoghurt or fruit crumble and custard, will add extra vitamin B<sub>12</sub>.</b>	
<b>SNACKS</b>	
• 1 slice of bread and 1 teaspoon of Marmite	0.7
• 1 tablespoon of liver paté on 2 crackers	1.0
• Fruit smoothie with 250ml milk and pottle yoghurt	1.2
• A pottle of yoghurt	0.4

## WHAT DOES THIS MEAN FOR HEALTH PROFESSIONALS?

- Check strict vegetarians or vegans are eating fortified foods or taking a supplement particularly when pregnant or breastfeeding.
- Monitor infants of vegan mothers carefully to ensure vitamin B<sub>12</sub> sufficiency.
- Consider the many causes of vitamin B<sub>12</sub> deficiency when a diagnosis is made. Is it an inadequate intake or reduced ability to absorb vitamin B<sub>12</sub>?
- Encourage those planning a pregnancy to ensure an adequate intake of vitamin B<sub>12</sub>. Like folate, vitamin B<sub>12</sub> is most needed throughout pregnancy and breastfeeding and ideally should be adequate before pregnancy.
- Healthy adults can fulfil their vitamin B<sub>12</sub> requirement through just one serving of lean beef or lamb or a couple of sardines or mussels. Pregnant and breastfeeding women who eat red meat only need an additional yoghurt or ½ cup of milk to achieve their increased needs.

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