

## VITAMIN B12-THE PITBULL VITAMIN

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**Abstract:** Vitamin B12 is a powerhouse. It helps make DNA, nerve and blood cells, and is crucial for a healthy brain and immune system. Metabolism wouldn't run smoothly without it. It's only found in animal products like eggs, meat, shellfish, and dairy. Up to 15% of people don't get enough B12, and they're more likely to be vegetarians, have celiac disease or other digestion problems, or be an adult over 50. Methylcobalamin and 5-deoxyadenosylcobalamin are the forms of vitamin B12 that are active in human metabolism. Vitamin B12 is required for proper red blood cell formation, neurological function, and DNA synthesis. Vitamin B12 functions as a cofactor for methionine synthase and L-methylmalonyl-CoA mutase. Methionine synthase catalyzes the conversion of homocysteine to methionine. Methionine is required for the formation of S-adenosylmethionine, a universal methyl donor for almost 100 different substrates, including DNA, RNA, hormones, proteins, and lipids. L-methylmalonyl-CoA mutase converts L-methylmalonyl-CoA to succinyl-CoA in the degradation of propionate an essential biochemical reaction in fat and protein metabolism. Succinyl-CoA is also required for hemoglobin synthesis. Due to its role in energy metabolism, vitamin B12 is frequently promoted as an energy enhancer and an athletic performance and endurance booster. These claims are based on the fact that correcting the megaloblastic anemia caused by vitamin B12 deficiency should improve the associated symptoms of fatigue and weakness. However, vitamin B12 supplementation appears to have no beneficial effect on performance in the absence of a nutritional deficit.

**Key Words:** Vitamin B12, Pernicious anemia, Supplementation, Power house vitamin, Cobalamins.

### INTRODUCTION:

According to the *American Journal of Clinical Nutrition*, approximately 6% of people aged 60+ years are vitamin B12 deficient in the United Kingdom and the United States. Deficiency is much more common in developing countries, "starting in early life and persisting across life span." Vitamin B12 is a powerhouse. It helps make DNA, nerve and blood cells, and is crucial for a healthy brain and immune system. Metabolism wouldn't run smoothly without it. It's only found in animal products like eggs, meat, shellfish, and dairy. Up to 15% of people don't get enough B12, and they're more likely to be vegetarians, have celiac disease or other digestion problems, or be an adult over 50.

Vitamin B12 is a water-soluble vitamin that is naturally present in some foods, added to others, and available as a dietary supplement and a prescription medication. Vitamin B12 exists in several forms and contains the mineral cobalt [1-4], so compounds with vitamin B12 activity are collectively called "cobalamins".

### PHYSIOLOGICAL IMPORTANCE OF VITAMIN B12:

Methylcobalamin and 5-deoxyadenosylcobalamin are the forms of vitamin B12 that are active in human metabolism [5]. Vitamin B12 is required for proper red blood cell formation, neurological function, and DNA synthesis [1-5]. Vitamin B12 functions as a cofactor for methionine synthase and L-methylmalonyl-CoA mutase. Methionine synthase catalyzes the conversion of homocysteine to methionine [5,6]. Methionine is required for the formation of S-adenosylmethionine, a universal methyl donor for almost 100 different substrates, including DNA, RNA, hormones, proteins, and lipids. L-methylmalonyl-CoA mutase converts L-methylmalonyl-CoA to succinyl-CoA in the degradation of propionate [3,5,6], an essential biochemical reaction in fat and protein metabolism. Succinyl-CoA is also required for hemoglobin synthesis.

**VITAMIN B12 ABSORPTION:**

Vitamin B12, bound to protein in food, is released by the activity of hydrochloric acid and gastric protease in the stomach [5]. When synthetic vitamin B12 is added to fortified foods and dietary supplements, it is already in free form and, thus, does not require this separation step. Free vitamin B12 then combines with intrinsic factor, a glycoprotein secreted by the stomach's parietal cells, and the resulting complex undergoes absorption within the distal ileum by receptor-mediated endocytosis [5,7]. Approximately 56% of a 1 mcg oral dose of vitamin B12 is absorbed [8].

**SOURCES OF VITAMIN B12:**

Vitamin B12 is naturally found in animal products, including fish, meat, poultry, eggs, milk, and milk products. Vitamin B12 is generally not present in plant foods, but fortified breakfast cereals are a readily available source of vitamin B12 with high bioavailability for vegetarians. Some nutritional yeast products also contain vitamin B12 [5,13-15].

**VITAMIN B12 ASSESSMENT:**

Assessment is done by serum or plasma vitamin B12 levels. Values below approximately 170–250 pg/mL (120–180 picomol/L) for adults [5] indicate a vitamin B12 deficiency. An elevated serum homocysteine level (values >13 micromol/L) [12] might also suggest a vitamin B12 deficiency. However, this indicator has poor specificity because it is influenced by other factors, such as low vitamin B6 or folate levels [5]. Elevated methylmalonic acid levels (values >0.4 micromol/L) might be a more reliable indicator of vitamin B12 status because they indicate a metabolic change that is highly specific to vitamin B12 deficiency [5-7, 12].

**CAUSES:**

Pernicious anemia is caused by an autoimmune disease; a person's own immune system attacks good parts of the body, as if they were bacteria or viruses. The immune system of patients with pernicious anemia creates antibodies which attack the lining of the stomach, damaging cells that produce intrinsic factor. Intrinsic factor is a substance that is secreted by the gastric mucous membrane (lining of the stomach) and is vital for the absorption of vitamin B12 in the intestines. If the production of intrinsic factor is undermined, vitamin B12 cannot be absorbed into the body properly.

Crohn's diseased people, as well as people who have had their bowels surgically shortened, may have problems absorbing vitamin B12 into their bloodstream. Patients with short bowel syndrome typically experience diarrhea, cramping and heartburn. It is not uncommon for individuals to become malnourished because what is left of the small intestine cannot absorb adequate quantities of vitamins, water and other nutrients.

Vegan diet people may suffer from B12 deficiency if they do not eat fortified foods, or some types of yeast. The human body cannot use the plant-based form of the vitamin. Chronic alcoholism may also be a cause of B12 deficiency, according to the National Library of Medicine [12].

**SYMPTOMS OF VITAMIN B12 DEFICIENCY:**

For our cells to multiply properly, an adequate level of vitamin B12 is required. The human body produces millions of red blood cells every minute. This production goes down if vitamin B12 levels are deficient, resulting in anemia as the red blood cell count drops. Common symptoms of anemia are Fatigue, Panting, and Palpitations. B12 deficiency anemia may also be caused by a lack of intrinsic factor. Symptoms of pernicious anemia may include; Fatigue, Shortness of breath, Palpitations. If the deficiency continues untreated the patient may have the following neurological signs and symptoms: Tingling or numbness of the fingers, Tingling or numbness of the toes, General muscle weakness, Difficulty walking properly (staggering), Irritability, Confusion, Forgetfulness, Tender calves [14].

**PREVENTION OF B12 DEFICIENCY:**

Vegetarians, who do not eat eggs, as well as vegans, should make sure their B12 intake is adequate. There are various breakfast cereals which are fortified with vitamin B12. Some brands of nutritional yeast are also good

sources of B12. Some types of soy milk are fortified with B12. A standard multivitamin contains 6 micrograms of vitamin B12, which is more than enough to cover an average person's daily requirement. For those who eat meat or fish, a balanced diet containing fish, meat and dairy foods should have enough B12 for human requirements. There is no way to prevent pernicious anemia caused by an autoimmune condition [11].

### **VITAMIN B12 AND HEALTH:**

Cardiovascular disease is the most common cause of death in industrialized countries, such as the United States, and is on the rise in developing countries. Risk factors for cardiovascular disease include elevated low-density lipoprotein (LDL) levels, high blood pressure, low high-density lipoprotein (HDL) levels, obesity, and diabetes [27]. Elevated homocysteine levels have also been identified as an independent risk factor for cardiovascular disease [28,30]. Researchers have long been interested in the potential connection between vitamin B12 deficiency and dementia [47,69]. A deficiency in vitamin B12 causes an accumulation of homocysteine in the blood [6] and might decrease levels of substances needed to metabolize neurotransmitters [32].

### **FACTS ABOUT VITAMIN B12:**

In dietary supplements, vitamin B12 is usually present as cyanocobalamin [5], a form that the body readily converts to the active forms methylcobalamin and 5-deoxyadenosylcobalamin. Dietary supplements can also contain methylcobalamin and other forms of vitamin B12. Existing evidence does not suggest any differences among forms with respect to absorption or bioavailability. However the body's ability to absorb vitamin B12 from dietary supplements is largely limited by the capacity of intrinsic factor [8]. In addition to oral dietary supplements, vitamin B12 is available in sublingual preparations as tablets or lozenges. These preparations are frequently marketed as having superior bioavailability, although evidence suggests no difference in efficacy between oral and sublingual forms [16,17].

Vitamin B12, in the form of cyanocobalamin and occasionally hydroxocobalamin, can be administered parenterally as a prescription medication, usually by intramuscular injection [12]. Parenteral administration is typically used to treat vitamin B12 deficiency caused by pernicious anemia and other conditions that result in vitamin B12 malabsorption and severe vitamin B12 deficiency [12].

Individuals with pernicious anemia cannot properly absorb vitamin B12 in the gastrointestinal tract [3,5,9,10]. A condition that affects 1%–2% of older adults [11], is characterized by a lack of intrinsic factor. Pernicious anemia is usually treated with intramuscular vitamin B12. However, approximately 1% of oral vitamin B12 can be absorbed passively in the absence of intrinsic factor [11], suggesting that high oral doses of vitamin B12 might also be an effective treatment.

Large amounts of folic acid can mask the damaging effects of vitamin B12 deficiency by correcting the megaloblastic anemia caused by vitamin B12 deficiency [3,5] without correcting the neurological damage that also occurs [1,18]. Moreover, preliminary evidence suggests that high serum folate levels might not only mask vitamin B12 deficiency, but could also exacerbate the anemia and worsen the cognitive symptoms associated with vitamin B12 deficiency [6,11]. Permanent nerve damage can occur if vitamin B12 deficiency is not treated. For these reasons, folic acid intake from fortified food and supplements should not exceed 1,000 mcg daily in healthy adults [5].

Atrophic gastritis, a condition affecting 10%–30% of older adults, decreases secretion of hydrochloric acid in the stomach, resulting in decreased absorption of vitamin B12 [5,11,19]. Decreased hydrochloric acid levels might also increase the growth of normal intestinal bacteria that use vitamin B12, further reducing the amount of vitamin B12 available to the body [21]. Individuals with atrophic gastritis are unable to absorb the vitamin B12 that is naturally present in food. Most, however, can absorb the synthetic vitamin B12 added to fortified foods and dietary supplements. As a result, adults older than 50 years obtain most of their vitamin B12 from vitamin supplements or fortified foods [5]. However, some elderly patients with atrophic gastritis require doses much higher than the RDA to avoid subclinical deficiency [22].

Individuals with stomach and small intestine disorders, such as celiac disease and Crohn's disease, may be unable to absorb enough vitamin B12 from food to maintain healthy body stores [12]. Subtly reduced cognitive function

resulting from early vitamin B12 deficiency might be the only initial symptom of these intestinal disorders, followed by megaloblastic anemia and dementia.

Surgical procedures in the gastrointestinal tract, such as weight loss surgery or surgery to remove all or part of the stomach, often result in a loss of cells that secrete hydrochloric acid and intrinsic factor [5,23,24]. This reduces the amount of vitamin B12, particularly food-bound vitamin B12 [25], that the body releases and absorbs. Surgical removal of the distal ileum also can result in the inability to absorb vitamin B12. Individuals undergoing these surgical procedures should be monitored preoperatively and postoperatively for several nutrient deficiencies, including vitamin B12 deficiency [26].

Strict vegetarians and vegans are at greater risk than lacto-ovo-vegetarians and non-vegetarians of developing vitamin B12 deficiency because natural food sources of vitamin B12 are limited to animal foods [5]. Fortified breakfast cereals are one of the few sources of vitamin B12 from plants and can be used as a dietary source of vitamin B12 for strict vegetarians and vegans.

Vitamin B12 crosses the placenta during pregnancy and is present in breast milk. Exclusively breastfed infants of women who consume no animal products may have very limited reserves of vitamin B12 and can develop vitamin B12 deficiency within months of birth [5]. Undetected and untreated vitamin B12 deficiency in infants can result in severe and permanent neurological damage.

Due to its role in energy metabolism, vitamin B12 is frequently promoted as an energy enhancer and an athletic performance and endurance booster. These claims are based on the fact that correcting the megaloblastic anemia caused by vitamin B12 deficiency should improve the associated symptoms of fatigue and weakness. However, vitamin B12 supplementation appears to have no beneficial effect on performance in the absence of a nutritional deficit [33].

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