Vitamin B12 (Cyanocobalamin)
Snapshot Monograph

Vitamin B12
(Cyanocobalamin)

Most Frequent Reported Uses:
- Homocysteine regulation
- Neurological health, including diabetic neuropathy, cognitive function, vascular dementia, stroke prevention
- Anemias, including pernicious and megaloblastic
- Sulfite sensitivity

Nutrient name(s):
Vitamin B12
Cyanocobalamin
Methylcobalamin
Adenosylcobalamin (Cobamamide)
Hydroxycobalamin (European)

Introduction:
Vitamin B\textsubscript{12} was isolated from liver extract in 1948 and reported to control pernicious anemia. Cobalamin is the generic name of vitamin B\textsubscript{12} because it contains the heavy metal cobalt, which gives this water-soluble vitamin its red color. Vitamin B\textsubscript{12} is an essential growth factor and plays a role in the metabolism of cells, especially those of the gastrointestinal tract, bone marrow, and nervous tissue.

Several different cobalamin compounds exhibit vitamin B\textsubscript{12} activity. The most stable form is cyanocobalamin, which contains a cyanide group that is well below toxic levels. To become active in the body, cyanocobalamin must be converted to either methylcobalamin or adenosylcobalamin. Adenosylcobalamin is the primary form of vitamin B12 in the liver.
A protein in gastric secretions called *intrinsic factor* binds to vitamin B\textsubscript{12} and facilitates its absorption. Without intrinsic factor, only a small percentage of vitamin B\textsubscript{12} is absorbed. Once absorbed, relatively large amounts of vitamin B\textsubscript{12} can be stored in the liver. The body actually reabsorbs vitamin B\textsubscript{12} in the intestines and returns much of it to the liver, allowing for very little to be excreted from the body. However, when there are problems in the intestines, such as the microflora being imbalanced resulting in gastrointestinal inflammation, then vitamin B\textsubscript{12} deficiencies can occur. A poor diet, high in refined sugars and carbohydrates, and many medications can also deplete vitamin B\textsubscript{12} from the body.

**Functions:**

- **Methyl Donor:** Primary functions of vitamin B\textsubscript{12} is as a methyl donor, transferring methyl groups in the following:
  a) Vitamin B\textsubscript{12} demethylates methyltetrahydrofolate to generate tetrahydrofolate, necessary in the synthesis of DNA. This means B\textsubscript{12} plays a role in the replication of the genetic code and is a growth factor in all cells of the body.
  b) Methylcobalamin transfers a methyl group onto homocysteine, which facilitates the conversion of homocysteine to methionine. Elevated levels of homocysteine are associated with an increased risk of several chronic diseases, including insulin resistance/type 2 Diabetes, cardiovascular diseases, digestive conditions, bone health and neurological conditions including decreasing cognitive function.
- **Neurological Health:** Required for the synthesis of myelin, the insulation around nerves. It plays a major role in the functioning and maintenance of the nervous system.
- Hydrogen Carrier: Functions as a hydrogen carrier in hydrogen transfer reactions.
- Red Blood Cells: Necessary for the maturation of red blood cells.
- Metabolism: Involved in various aspects of protein, fat, and carbohydrate metabolism.

**Dosage:**

Cyanocobalamin (oral)

**DRI**
3.0mcg daily

**ODA**
10 – 1,000 mcg daily

* The Dietary Reference Intakes (DRI) are the most recent set of dietary recommendations established by the Food and Nutrition Board of the Institute of Medicine, 1997-2001. They replace previous RDAs, and may be the basis for eventually updating the RDIs.

**The Optimum Daily Allowance (ODA) represents a reference level beyond the RDI, and is often many times higher than the RDI to prevent diseases such as aging or cancer. These numbers are based on clinical use.*
Methylcobalamin: 1,500 – 6,000 mcg/day in divided doses
Aenosylcobalamin: 3,000 mcg/day

**Symptoms of Deficiency:**
- Vitamin B₁₂ deficiencies manifest primarily as anemia and neurological changes. Vitamin B₁₂ deficiency inhibits DNA synthesis, which affects the growth and repair of all cells. The symptoms of vitamin B₁₂ deficiency include: fatigue, peripheral neuropathy, tongue and mouth irregularities, megaloblastic anemia (abnormally enlarged red blood cells), depression, confusion and memory loss (especially in the elderly), poor blood clotting and easy bruising, dermatitis and skin sensitivity, loss of appetite, nausea and vomiting.
- Pernicious anemia is normally the first symptom of vitamin B₁₂ deficiency. A B₁₂ deficiency causes a reduction in the rate of mitosis, which allows abnormally large cells to form, hence the term megaloblastic anemia.
- The elderly are most susceptible to vitamin B₁₂ deficiency due to atrophy of gastric parietal cells causing inadequate production of intrinsic factor.
- Deficiencies in the elderly manifest with neuropsychiatric symptoms such as moodiness, confusion, abnormal gait, memory loss, agitation, delusions, dizziness, dementia, and hallucinations.
- Meatless diets are deficient in vitamin B₁₂. Strict vegetarians are urged to use a vitamin B₁₂ supplement.
- Those with an increased need for vitamin B₁₂ include:
  - Memory related issue
  - Substance Abusers
  - Chronic Illness
  - Recent Surgery
  - Burns
  - Malignancies of Pancreas or Bowel
  - Vegetarians
- The following drugs can cause a depletion of vitamin B₁₂, which may increase an individual’s need for vitamin B₁₂:
  - Oral contraceptives
  - Antibiotics
  - Antivirals including didanosine, lamivudine, stavudine, zalcitabine, and zidovudine
  - Biguanides, metformin
  - Bile acid sequestrants including cholestyramine and colestipol
  - Clofibrate and fenofibrate
  - Colchicine
  - H-2 receptor antagonists including cimetidine, famotidine, nizatidine, and ranitidine
  - Phenytoin
  - Proton pump inhibitors including lansoprazole and omeprazole
- Timed-release potassium chloride medications

**Side Effects and Warnings:**
- There are no known toxicities associated with vitamin B₁₂.
- There are some reports in the literature of increased circulating levels of vitamin B₁₂ and folic acid leading to a weak, but positive association to an increased incidence of prostate cancer (Collin et al, 2010; Collin, 2013). The 2008 European Prospective Investigation into Cancer and Nutrition study reported that there were no significant associations observed from circulating concentrations of folate or vitamin B₁₂ and the risk of prostate cancer (Johansson et al, 2008).

**Food Sources:**
- Vitamin B₁₂ is produced by microbial synthesis in the digestive tract of animals. Hence, animal protein products are the source of this nutrient. It does not occur in fruits, vegetables, grain, or legumes. Organ meats are the best source of vitamin B₁₂, followed by clams, oysters, beef, eggs, milk, chicken, and cheese.
Vitamin B12
Patient Snapshot

Uses:
- Vitamin B12 is essential for functions in the metabolism of cells, especially those of the GI tract, bone marrow, and nervous tissue.
- Vitamin B12, along with vitamin B6 and folic acid, help decrease a compound in the body called homocysteine. Homocysteine is associated with an increased risk of many chronic diseases, including memory impairment, blood sugar regulation, heart and blood vessel disease.

Dosage:
DRI*
3.0mcg daily

ODA**
10 – 100mcg daily

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Special Concerns:
- If you are taking prescription or non-prescription medications, have a pre-existing medical condition, or are pregnant and/or breastfeeding, talk with your healthcare provider before taking any dietary supplement.
- If you are at risk for prostate cancer or prostate diseases, make sure to talk with your doctor before taking vitamin and mineral supplements.
- Do not take if there is an allergy to any component of this dietary supplement.
- Those with an increased need for vitamin B12 include:
  - Vegetarians
  - Substance Abusers
  - Chronic Illness
  - Recent Surgery
  - Burns
  - Cancer of Pancreas or Bowel
- The following medications may deplete vitamin B12 from the body. When taking these medications, it is best to supplement your diet with vitamin B12:
  - Oral contraceptives
  - Antibiotics
  - Antivirals including didanosine, lamivudine, stavudine, zalcitabine, and zidovudine
  - Biguanides, metformin
  - Bile acid sequestrants including cholestyramine and colestipol
  - Clofibrate and fenofibrate
  - Colchicine
  - H-2 receptor antagonists including cimetidine, famotidine, nizatidine, and ranitidine
  - Phenytoin
  - Proton pump inhibitors including lansoprazole and omeprazole
  - Timed-release potassium chloride medications

DISCLAIMER: Statements made are for educational purposes and have not been evaluated by the US Food and Drug Administration. They are not intended to diagnose, treat, cure, or prevent any disease. If you have a medical condition or disease, please talk to your doctor prior to using the recommendations given.
References:


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