

**VITAMIN B12: PRIMER FOR BODY'S CELL FUNCTION****Syeda Zuleqa¹, Sumayya Sajida^{2*} and Fariya Azeem³**¹Assistant Professor, Deccan School of Pharmacy²Student, Deccan School of Pharmacy (Affiliated to OU)³Student, Deccan School of Pharmacy (Affiliated to OU)

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ABSTRACT

Vitamin B12, also called cobalamine, is a water soluble vitamin that is involved in the metabolism of every cell of human body. It is a co-factor in DNA synthesis, and in both fatty acid and amino acid metabolism. It is particularly important in the normal functioning of the nervous system via its role in the synthesis of myelin, and in the maturation of red blood cells. The main sources of vitamin B-12 are bacteria archaea, animals, plants, algae, and fortified food. Good dietary sources of vitamin B-12 include beef, pork, ham, poultry, lamb, fish, dairy products such as milk, cheese, yougat and eggs etc., supplements can be taken orally or in a nasal spray. vegans can take supplements to avoid deficiency, as the vegan diet remove the meat products that provide vitamin B-12 naturally. the main function of vitamin B-12 include protects human heart, bones, prevents nerve

damage improve mood and outlook, protects brain health, keeps you look good and feel young. vitamin B-12 is taken by mouth, skin and injection to prevent and treat its deficiency for alzheimer's, heart disease, neural tube defect, crohn's disease, Perinicious Anaemia, lyme disease, GERD, osteoporosis, pregnancy, diabetes, hairloss, AMD etc.

KEYWORDS: Vitaminb12, Functions, Physiology, Chronic Diseases.

INTRODUCTION

Vitamin B12 is a water soluble vitamin, like other B-vitamins. This means it dissolves in water and travel through the blood stream. The human body can store vitamin B12 for up to 4 years. Any excess of unwanted vitamin B12 is excreted in the urine.^[1]

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SOURCES

Most omnivorous people in developed countries obtain enough vitamin B12 from consuming animal products including meat, fish, eggs and milk, but there are no vegan sources other than B12 fortified foods or B12 supplements.^[2]

BACTERIA AND ARCHAEA: B12 is only produced in nature by certain bacteria and archaea. It is synthesized by some bacteria in gut flora in humans and other animals.

ANIMALS: Animals store vitamin B12 in liver and muscle and some pass the vitamin into their eggs and milk; meat, liver, eggs and milk are therefore sources of the vitamin for other animals as well as humans.

PLANTS AND ALGAE: Natural sources of vitamin B12 include dried and fermented plant foods such as tempeh, and laver, a seaweed. Many other types of algae are rich in vitamin B12, with some species, such as *Porphyra yezoensis*, containing as much cobalamin as liver.

FORTIFIED FOODS: Every vegan who is not consuming adequate vitamin B12 from fortified foods take supplements. Foods for which B12 fortified versions are widely available include breakfast cereals, soy products, energy bars and nutritional yeast.^[2]

DIETARY SOURCES



Fig: Dietary sources.

Vitamin B12 can be found naturally in animal products such as fish, meat, eggs and dairy products. It does not typically occur in plant foods.

Good dietary sources of vitamin B12 include

- Beef
- Pork
- Ham
- Poultry
- Lamb
- Fish, especially haddock and tuna
- Dairy products, such as milk, cheese and yogurt
- Some nutritional yeast products
- Eggs

SUPPLEMENT

Supplements can be taken orally or in a nasal spray. However oral supplements do not help in many cases of deficiency. In these circumstances vitamin B12 may be injected.

Vegans can take supplements to avoid deficiency, as the vegan diet removes the meat products that provide vitamin B12 naturally. This is particularly important during pregnancy and while breast feeding.(1)

BENEFITS

Vitamin B12 is crucial to the normal functioning of the brain and the nervous system. It is also involved in the formation of red blood cells and helps to create and regulate DNA.

The human body produces millions of red blood cells every minute. These cells cannot multiply properly without vitamin B12. The production of red blood cells reduces if vitamin B12 levels are too low. Anemia can occur if the red blood cell count drops.⁽¹⁾

INTAKE REQUIREMENTS

Teens and adults over the age of 14 years should consume 24 micrograms [mcg] of vitamin B12 a day. Pregnant women should be sure to consume 2.6 mcg, and lactating women 2.8 mcg.

Excessive intake of vitamin B12 has not demonstrated toxic or harmful qualities. However, people are always advised to speak with their physician before starting to take supplements.^[1]

FUNCTIONS

1. SUPPORT ENERGY: It keep your cells fed happy and healthy. Without it your cells get hungry and you feel weak, tired and like you're dragging all the time. The nutrient releases energy into the cell and provides you with the appropriate balance you need for thinking and moving throughout the day.

2. PROTECTS YOUR HEART: One of its job is to remove a dangerous protein called homocysteine from the blood. If homocysteine is allowed to roam through blood, it damages your arteries leading to inflammation and heart disease.

3. YOUR BONES NEED IT: Studies have found patients with osteoporosis have higher levels of homocysteine and low levels of B12 than people with strong, healthy bones.

4. PREVENT NERVE DAMAGE: Your nerves have a protective covering to keep them safe from toxins and free radicals in your blood. Without these coverings, called myelin sheaths, exposed nerves get damaged and may even die.

5. IMPROVES MOOD AND OUTLOOK: Your brain uses a chemical called serotonin to regulate your mood. If you aren't getting enough B12, you may find yourself feeling down.

6. PROTECTS BRAIN HEALTH: Researchers have noted Alzheimer's patients have much lower levels of B12 than those of a similar age who have sharp, clear memory. In the same way B12 helps protect nerve cells, it helps protect the myelin sheaths of brain cells that are often lacking in Alzheimer's patients.

7. KEEPS YOU LOOKING AND FEELING YOUNG: Aging happens when your cells begin to wear and tear, and they age faster when your DNA doesn't replicate correctly. B12 supports DNA health, thereby keeping your cells younger. And when your cells are young, you look and feel young too.^[3]

SIDE EFFECTS

The side effects of taking vitamin B12 are very limited. It is not considered to be toxic in high quantities, and even 1000mcg doses are not thought to be harmful.

Cyanocobalamin is an injectable form of the supplement that contains traces of cyanide, a poisonous substance. However, many fruits and vegetables contain these traces, and it is not considered a significant health risk.^[1]

DEFICIENCY SYMPTOMS

Vitamin B12 deficiency occurs when the body does not receive enough vitamin B12.

It can result in irreversible and potentially severe damage, especially to the nervous system and brain.

Vitamin B12 deficiency carries a serious risk of permanent nerve and brain damage. Some people with insufficient vitamin B12 have a higher risk of psychosis and dementia.

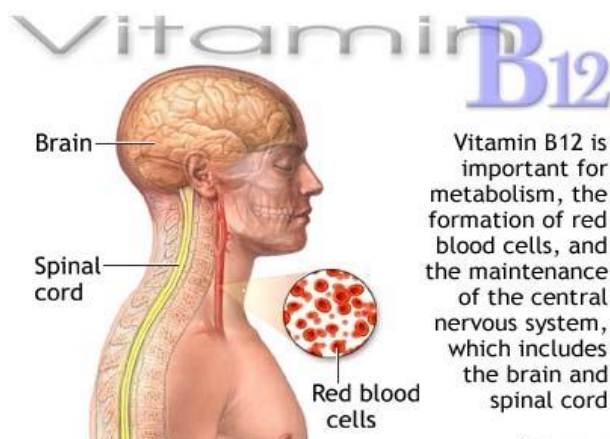
Insufficient vitamin B12 can also lead to anaemia.

Other deficiencies are Crohn's disease, Celiac disease, diabetes, fatigue, depression, constipation, reflex problems, feeding difficulties, irritation and eventual growth problems.^[1]

FUNCTION OF VITAMIN B12 IN THE CENTRAL NERVOUS SYSTEM

The CNS injury appears to occur during the first 6 months of postnatal life. The same symptoms are seen in acquired cobalamin deficiency in the same age group. MRI performed at age 18-19 months and after 13-14 months of large amounts of cobalamin in two cases showed delayed myelination, most pronounced in the cerebrum. Isolated methycobalamin

deficiency is the consequence of cblE and G mutations where the lesion is of a single Cbl-dependent enzyme, the methyltransferase.^[4]



FUNCTION OF VITAMIN B12 IN CARDIOVASCULAR SYSTEM

One of vitamin B12's metabolic functions is to help convert homocysteine, an amino acid that in excess ups the risk for cardiovascular disease, to a useful amino acid needed for protein synthesis. Although vitamin B12 supplementation can effectively reduce homocysteine levels, so far taking it in supplement form has not been found to curb cardiovascular disease.

FUNCTION OF VITAMIN B12 IN ERYTHROPOESIS: Erythropoiesis is the process in which new erythrocytes are produced. These new erythrocytes replace the oldest erythrocytes (normally about one percent) that are phagocytosed and destroyed each day. Erythroblasts require folate and vitamin B12 for proliferation during their differentiation. Deficiency of folate or vitamin B12 inhibits purine and thymidylate syntheses, impairs DNA synthesis, and causes erythroblast apoptosis, resulting in anemia from ineffective erythropoiesis.^[5]

FUNCTION OF VITAMIN B12 IN BONE FUNCTIONING

Vitamin B12 deficiency has also been shown to increase the risk for bone fractures. Tufts University researchers found that men and women with low-plasma vitamin B12 levels had lower bone-mineral density at the hip and spine, respectively. The link was still significant even after adjusting for homocysteine (a risk factor for bone fracture), which suggests that modifying vitamin B12 levels could help prevent osteoporosis.^[6]

FUNCTION OF VITAMIN B12 IN GENETICS [DNA MODULATION MECHANISM]

Vitamin B12 is important for DNA synthesis and ensures structural stability of important regions of the chromosomes such as the centromeres and the subtelomeric DNA. As methyl-donor, it participates in the monocarbonic acid metabolic pathway, which is especially important during embryogenesis and carcinogenesis. DNA-methylation is catalyzed by DNA methyl-transferases that transfer methyl groups from S-adenosylmethionine (SAM) to cytosine. Vitamin B12 and other methyl donors such as pyridoxal 5'-phosphates (PLP) and folate, are necessary as coenzymes of methyltransferase and lead to the remethylation of homocysteine to methionine. B12 is also responsible for the conversion of methyl-THF to tetrahydrofolate (THF).^[6]

FUNCTION OF VITAMIN B12 IN VARIOUS DISEASES AND DISORDERS

VITAMIN B12 IN LIVER DISEASE: Concentrations of cyanocobalamin (vitamin B₁₂) in serum have been found to be elevated in acute and chronic liver disease associated with hepatocellular damage. In acute viral hepatitis the rise in serum cyanocobalamin was most pronounced in the first two weeks of the disease, when bilirubinemia is marked and the liver-function tests indicative of hepatocellular damage are positive.^[9]

VITAMIN B12 IN CARDIOVASCULAR DISEASE: Nutritional risk factors for CVD include hypercholesterolaemia, hypertension and obesity. Elevated tHcy concentrations are also considered a risk factor, however, it is unclear if tHcy is a modifiable risk factor or an independent marker of the disease process.^[8]

VITAMIN B12 IN NEURAL TUBE DEFECTS: NTD include spina bifida, anencephaly, and encephalocele. These are caused by the failure of the neural tube to close during gestation. The aetiology of NTD is not fully understood but risk factors include folate deficiency, genetic and environmental factors.

CROHN'S DISEASE: Vitamin B12 gets absorbed by the terminal ileum, which is the end of the small intestine. It's possible that disease in that portion of the bowel has made it impossible for a patient to absorb enough B12 from food or supplements to meet crucial needs. Since a deficiency can cause damage to the brain and spinal cord. When the portion of the bowel that absorbs B12 has been removed or is too diseased to process enough of the vitamin, the patient needs supplementation other than by oral means. That typically means monthly B12 injections or a weekly nasal spray. A patch is also now on the market.^[10]

PERINICIOUS ANAEMIA: Doctors treat pernicious anemia by replacing the missing vitamin B12 in the body. People who have pernicious anemia may need lifelong treatment. Pernicious anemia usually is easy to treat with vitamin B12 shots or pills.^[8]

ALZHEIMER'S DISEASE: A French review of studies on diet and dementia highlights the fact that Alzheimer's sufferers almost always have low vitamin B12 levels. People with below-average B12 levels were six times more likely to experience "brain shrinkage." While the precise mechanism of this effect is not thoroughly understood, researchers believe that low levels of B12 may inhibit proper DNA repair, which over time can lead to memory loss. Aside from treating vitamin B-12 deficiency, there's no clear evidence that vitamin B-12 supplements improve memory for people with Alzheimer's disease.^[11]

GASTROESOPHAGEAL REFLUX DISEASE [GERD]: GERD (gastroesophageal reflux disease), is also known as acid reflux, such as H2 blockers and proton-pump inhibitors, may contribute to a vitamin B12 deficiency.

Proton-pump inhibitors slow the release of gastric acid, which is needed to start digesting and absorbing vitamin B12 found in food. Yet to conclude that if proton-pump inhibitors interfere enough with digestion to result in low vitamin B12 levels. H2 blockers can interfere with vitamin B12 absorption because they slow the release of hydrochloric acid in the stomach. H2 inhibitors could cause problems in people who do not get enough vitamin B12 and who take the medication for more than two years.

DEGENERATIVE CERVICAL MYELOPATHY [DCM]: DCM is the commonest cause of spinal cord impairment. Patients at this age have also been reported to have a high prevalence of vitamin B12 deficiency, with estimates of up to 20% in the elderly. Vitamin B12 deficiency can result in subacute combined degeneration of the spinal cord (SACD), and several case reports have pointed to patients with both DCM and SACD. Both SACD and reversible compressive injury is due to DCM necessitate remyelination in the spinal cord, a process that requires adequate vitamin B12 levels.

OSTEOPOROSIS: Osteoporosis increases morbidity and dependence, which in turn decrease the quality of life and create a burden on health care costs. This problem will increase with the growing number of elderly people and will result in a higher number of osteoporotic fractures.^[8]

VITAMIN B12 IN PREGNANCY: Essential for baby's neural tube formation, brain and spine development. Together with Folate (B9), it works to produce DNA synthesis and red blood cells. Aids the development and functioning of your brain, nerves and blood cells. Helps improve your energy, mood and stress levels by aiding the metabolism of fats, carbohydrates, and proteins.

DIABETES MELLITUS: Diabetes mellitus can increase your risk of having a B-12 deficiency because it may be a side effect of metformin, a common treatment for type 2 diabetes mellitus.^[8]

LYME DISEASE: Vitamin B-12 deficiencies are common in people with Lyme disease, as well as in the general population. This is for many reasons, including the fact that B-12 absorption is complex and many people, especially those with Lyme, have poor digestion. Intestinal dysbiosis, leaky gut and other gastrointestinal conditions may cause Vitamin B-12 to not be well absorbed, as can low stomach acid, pernicious anemia, and certain medications like Metformin, stain drugs and some antibiotics, especially the "cycline" drugs like doxycycline.

HAIR LOSS: Vitamin is required to produce new hair cells and promote hair growth. During menopause, you may experience hair loss – in fact, this affects an estimated 40% of menopausal women. For most women, hair shedding is relatively mild, such as thinning around the temples.^[8]

CONCLUSION

Vitamin B-12 is a water soluble vitamin which must obtain through diet or supplement. Vitamin B-12 is a particular important vitamin for women of child bearing age and for older people, However adequate vitamin B-12 status over the whole of the life cycle is needed for optimal health. Its is responsibe for many bodily functions and may benefit our health in various ways, such as preventing the major birth defects, supporting bone health, improving mood and maintaining healthy skin and hair. Getting enough vitamin through our diet is crucial. However, if we struggle to obtain enough or have a condition that affect absorption, supplements area simple way to increase our vitamin B-12 intake.^[8]

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