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A Survey Study : Assessing The Prevalence Of Vitamin B And D Deficiency

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Abstract:

Vitamins are natural occurring substances found in small quantities in every foods. Inadequate intake of particular vitamin can increase the risk of developing specific health problems. Being organic compounds, vitamins contain carbons as fundamental components. Furthermore, vitamins are significant supplements that the body requires from dietary sources to bolster fundamental functions. Deficiency in vitamin D may be a open wellbeing concern all inclusive over all age socioeconomics. Vitamin D is basic for calcium digestion system as well as for break avoidance, The prevalence of clinical vitamin D deficiency, leading to conditions such as rickets and osteomalacia, is notably high in various regions worldwide, distinguishing is as a significant health concern. Think of plasma 25 hydroxy-vitamin D quantity as a potential indicator or signal for the presence of clinical vitamin D deficiency in the body. It serves as a sort of flag that alerts us to the possibility of not having enough vitamin D for optimal health. Vitamin B are soluble in water type vitamins necessary as coenzymes for chemicals basic to work of cell. The viability of B vitamins as cancer prevention agents avoiding oxidative push harmfulness is additionally surveyed. Their collective impacts are especially predominant to various viewpoints of brain work, including energy production, DNA or RNA synthesis or repair, genomic and non-genomic methylation, and the union of various neurochemicals and signaling atoms.

Keywords:

Vitamin D, 25-hydroxyvitamin D, Rickets, osteomalacia, vitamin B.

1. Introduction:

Vitamins are organic compounds, which are necessary in less amount for good health and metabolism, which can be easily get by normal balance diet [1] vitamins represents a class of intricately structured organic compound crucial for maintaining normal metabolism. Their absence can lead to various disorders, but replenishing these nutrients can alleviate deficiency symptoms. What sets vitamins apart is their diversity, akin to the complexity in facts, carbohydrate, and proteins, making them essential components of a balanced diet and overall health. Tiny quantities of vitamins are indispensable for processes like growth, development, maintaining health, and supporting reproduction [2]. Human body is not able to the production of vitamins so, they are taken through the diet. Vitamins have plays an essential for growing and progress of human anatomy.

Various vitamins include vitamin A, vitamin C (ascorbic acid), vitamin D, vitamin E, vitamin B12 (cobalamin), vitamin B6, vitamin B5 (Pantothenic acid), vitamin B1 (Thiamin), vitamin B3 (niacin), vitamin B2 (riboflavin), and vitamin B9 (folate, folic acid). Additionally, flavonoids, often referred to as vitamin P, are also essential nutrients. Deficiencies in vitamins can lead to severe diseases, some of which can be fatal. For example, vitamin B complex helps to decrease degeneration in the nervous system. Clinically, combinations of vitamin B1 (thiamine), vitamin B6 (pyridoxine), and vitamin B12 are administered to address neurological issues [2,3]. Vitamins, particularly vitamin B12, play crucial roles in various biological processes to maintain normal neural functions. Vitamin D deficiency impacts nearly 50% of the global population. Vitamin D is a soluble in fat type vitamin that is crucial for the bone metabolism also appears to possess as NSAID and immunomodulatory effects [4].

2. Vitamin B complex

The complex of vitamin B serve as soluble in water sustenance that can be easily taken by a fit stomach and are readily excrete out through kidney filtration rate these vitamins are valuable for their significant physiological functions and are essential participate to maintaining overall health. Several deficiencies in B-vitamins are relatively uncommon.

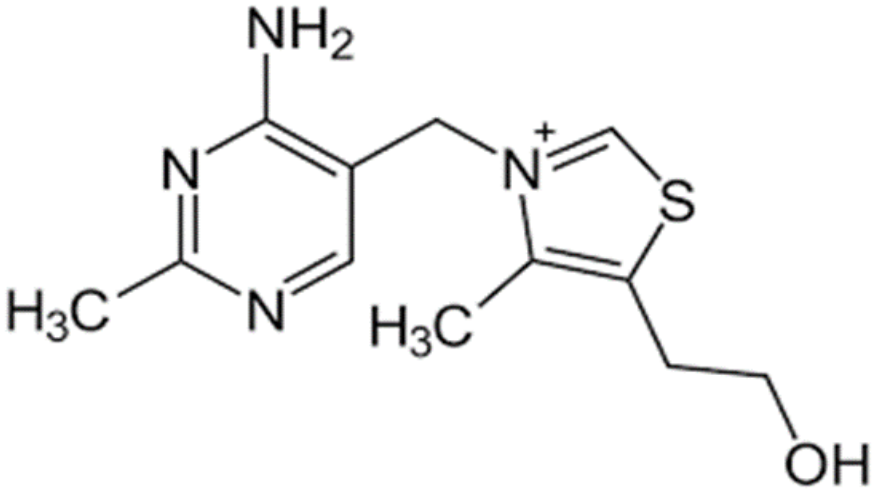
Hence, maintaining a healthy balanced diet that includes a comprehensive range of B-vitamins is occasionally necessary if any above them are found less. Conversely, their curative value is confined to addition nutrients in time of inadequacy, in presence of a sufficient dietary intake, the do not serve any additional purpose. (B1) Thiamin is necessary for the oxidative decarboxylative reactions carried out by the branched- chain ketoacid dehydrogenase enzyme system within the cycle of citric acid. Riboflavin (B2) is useful for the activity for flavoenzymes involved in the electron transport chain. Niacin (B3) is necessary for the synthesis of NADH and is essential for providing protons gradient for ATP synthesis. Pantothenic acid (B5) is used for the formation of coenzyme A and also involved in the activity of the α-ketoglutarate and pyruvate dehydrogenase complexes, also in oxidation of fatty acid. (B7) Biotin is the coenzyme of decarboxylases essential for the oxidation process of fatty acid and also gluconeogenesis. Pyridoxine (B6) is crucial for healthy brain process also in maintaining the health of the neuro-immunological networks . Cobalamin (B12) has a crucial importance in formation of

red blood cells, neural works , also synthesis of DNA, that are intracellular molecules that carry genetically code or material.

2.1 Vitamin B1 (Thiamin)

19th and 20th centuries Nobel Prize–winning experiments is connected with the finding of thiamine, the discovery of thiamine highlighted that the absence of this vitamin in human can result in a prevalent ailment referred to as beriberi, which encompasses a important neurological aspects among its symptoms. The first discovered vitamin was Thiamine (vitamin B1), main part of vitamins. Wernicke encephalopathy (WE) primarily affects the central nervous system (CNS), while Korsakoff syndrome (KS) is characterized by amnesia with additional psychiatric manifestations. Wernicke-Korsakoff syndrome encompasses both neurological and psychiatric symptoms. These conditions highlight the importance of thiamine and other vitamins in preventing neurological disorders. As alcohol reduce the absorption of thiamine so the syndrome is often complicated by alcoholism.[6] Vitamin B1, thiamine, shows various action in the body. It shows important and more activity in biological medium and plays important part as cofactor of enzyme. Thiamine impacts cell metabolism through both direct enzymatic activity and indirect modulation of cellular processes.

A deficiency in thiamine in the people food may show to disordering in numerous critical metabolic also biochemical procedures. This type of disturbances may cover impaired metabolism of glucose, disrupted bioenergetic processes, mitochondrial infection, lactic acidosis, insufficient DNA formation due less transketolase activity, diminished ribose-5-phosphate formation in the pentose phosphate pathway, and damage neurotransmitter synthesis [7]. The absence of thiamine can also contribute to the development of several neurodegenerative diseases, including, Parkinson's disease, and Huntington's disease, Alzheimer's disease [7].There is a clinical disease Beriberi is caused by thiamine deficiency and obtained in three forms. One is the Genetic beriberi which is a less common characterized by the body's inability to effectively absorb thiamine. The rest two are occurs in form of wet beriberi and dry beriberi disease. Wet beriberi primarily impact the heart and blood vessels also may lead to failure of heart. Dry beriberi often accompanies neuropathies like Wernicke's encephalopathy and Korsakoff's syndrome, with Wernicke-Korsakoff syndrome developing when both neurological and psychiatric symptoms manifest together. Research has also investigated the prevalence of thiamine deficiency in intensive care units (ICUs), hospitals, and among the elderly population, particularly those over 76 years of age.



2.1. Chemical structure of Vitamin B1(Thiamin)

2.2 Vitamin B2 (Riboflavin)

Riboflavin, also known as vitamin B2, stands out as a crucial micronutrient due to its essential role in various metabolic processes within the body. It plays a vital role in biological as well as chemical reactions in biological cells. globally the most useful applications of riboflavin that it is used as nutritional supplement in human and animals. Staying updated on bases of last researches regarding riboflavin producing through fermentation processes is essential for advancing the evolution of current and enhanced microbial trait by using of the new technologies as metabolic engineering and biotechnology process. This knowledge contributes to maximizing vitamin B2 produce.[8] Riboflavin (vitamin B2) is soluble in water type vitamin which may easily obtained from by all types of plants and most of the microorganisms. It has a crucial importance in development and well reproductive process of humans and animals [9]. Riboflavin (B2) is essential for the activity of flavoenzymes involved in the respiratory chain.

2.2.1 FDA-Approved Indication

The FDA has granted approval for the use of a specialized eye treatment involving riboflavin 5'-phosphate. This formulation is specifically designed to address corneal ectasia that can occur after refractive surgery, along with managing the progression of keratoconus, a unique recognition of its effectiveness in these particular eye conditions.

2.2.2 Off-Label Uses

Off-label employments of verbal riboflavin incorporate headache prevention, and infants experiencing phototherapy.

2.2.3 Available Dosage Forms and Strengths

Riboflavin is also available as single-ingredient oral tablets containing 25 mg, 50 mg, and 100 mg, as well as oral capsules with strengths of 400 mg. Riboflavin is commonly available in combination with other water-soluble multivitamins. Additionally, riboflavin 5'-phosphate is available in the form of a 0.146% ophthalmic solution formulation [27].

2.2.4 dosage of Daily Riboflavin Intake

◆ Adults (aged 19 to 70): Recommended Riboflavin Dosage: 0.9-1.1 mg/d for Women and 1.1-1.3 mg/d for Men

◆ Adolescents (aged 10 to 18): The required dosage is 0.9 to 1.3 mg/d.

◆ Children (aged 1 to 9): The dosage range is 0.5 to 0.6 mg/d.

◆ Infants (aged 0 to 12 months): The dosage required is 0.3 to 0.4 mg/d.

◆ The dose for supplementation is generally 50 to 100 mg daily.[27] this is not only used for supplement deficiency but also prescribed in some of chemical situations. Those are as follows:

◆ **Corneal Ectasia Following Refractory Surgery and Progressive Keratoconus**

◆ Riboflavin is also present for topical ophthalmic use as riboflavin 5'-phosphate eye drop (0.146%) and riboflavin 5'-phosphate in 20% dextran solution (0.146%). These ophthalmic definitions are photo enhancers utilized in corneal collagen cross-linking to oversee keratoconus and corneal ectasia after refractive surgery. Riboflavin-5'-phosphate induces the formation of singlet oxygen, which enables cross-linking. The corneal cross-linking system (KXL) leads to rapid cross-linking between collagen fibres.[27,28].

◆ **Migraine Prophylaxis**

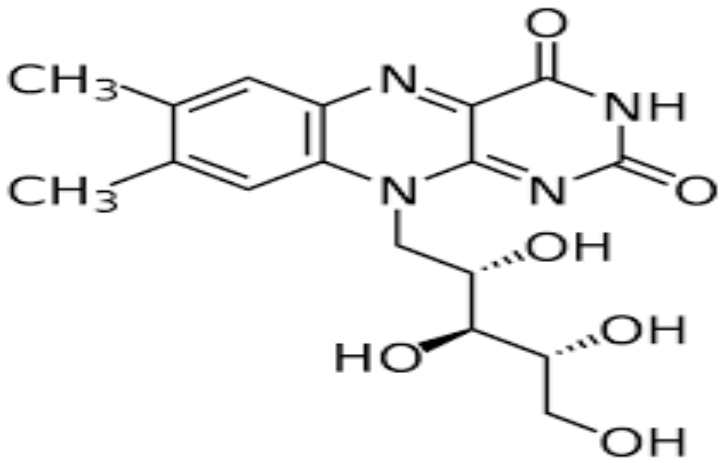
◆ Riboflavin is potent for the prophylaxis of migraines. The American Institute of Neurology (AAN) and American Cerebral pain Society rules underwrite the utilize. The typical measurements for headache prophylaxis is 400 mg daily.[28]

◆ **Specific Patient Populations**

◆ **Pregnancy considerations:** During pregnancy requirement of riboflavin increases. Low consumption of dairy products during pregnancy is cause of riboflavin deficiency. [28] Deficiency of riboflavin is a possible risk factor for preeclampsia.

◆**Breastfeeding contemplations**: Riboflavin requirement is expanded amid lactation. Maternal insufficiency of riboflavin may incline the newborn child to riboflavin deficiency. [28,27] Dairy items and meat are required to supply adequate riboflavin for the mother and infant.[29]

◆**Older patients:** Mostly Older patients with acute illness often have suboptimal riboflavin status, and supplementation with riboflavin and other nutrients are recommended.



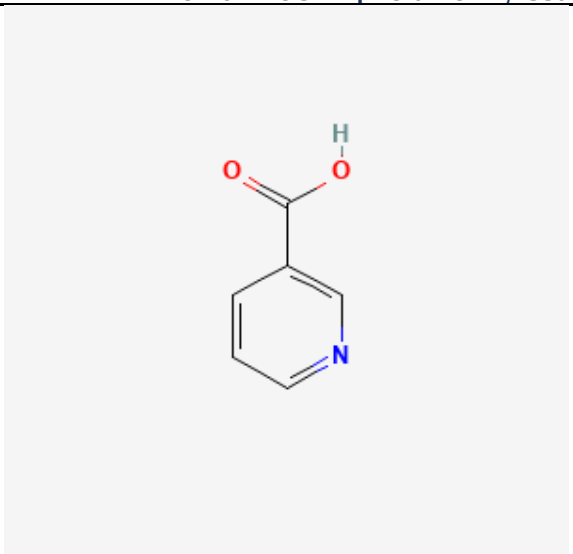
2.2 Chemical structure of vitamin B2(riboflavin)

2.3 Vitamin B3 (Niacin)

Vitamin B3, commonly known as niacin, comprises in different forms first in form of niacin (nicotinic acid), second in form of nicotinamide (niacinamide), and the last in form of nicotinamide riboside. These forms are changed inside the body as nicotinamide adenine dinucleotide. NAD is crucial for peoples life, and the human body cannot produce it internally without the presence of either vitamin B3 or tryptophan[10]. All individuals require a definite quantity of niacin may be by food or supplements for normal body function. This requirement is referred to as the dietary reference intake (DRI). For the niacin, the DRIs amount is required in different quantities and are recommended in milligrams of niacin equivalents.The most recommended daily dose for a mature person is 35 milligrams of niacin daily. Niacin (vitamin B3) is naturally present in various foods and other dietary supplements. Niacin is required for NADH synthesized also essential to provide protons for oxidative phosphorylation [5,6].

2.3.1 Pellagra

Pellagra may be a caused by a insufficiency of vitamin B3. Niacin plays a pivotal part within the treatment of pellagra, especially in soothing skin side effects, until the indications resolve.



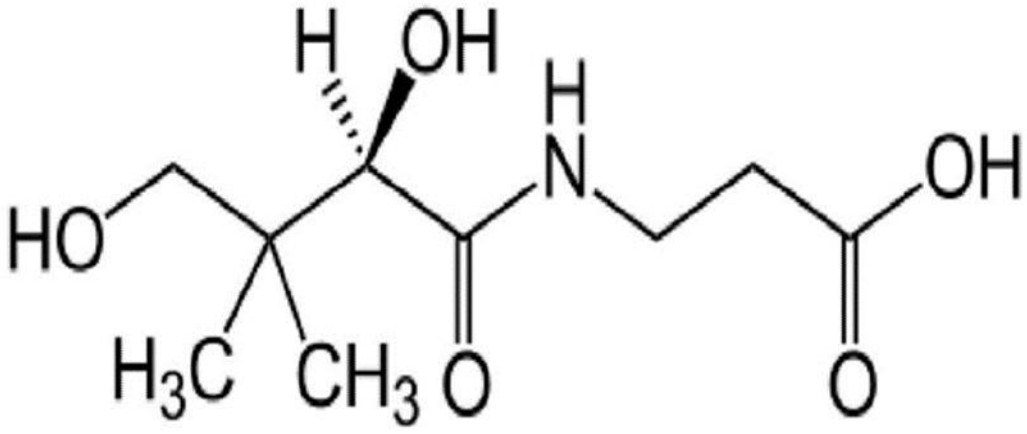
2.3 chemical structure of vitamin B3(Niacin)

2.4 Vitamin B5 (Pantothenic Acid)

Vitamin B5 (pantothenic acid) is soluble in water type vitamin present in edible foods . The human and animal also some of the bacteria , have limited capacity of formation pantothenic acid so the are depend on external sources[13]. Pantothenic acid is synthesized in various plants, fungus, and most of the bacteria. Pantothenic acid is broadly present in plants and animals origin food, making it a common component of the human diet. Vitamin B5, also known as D-pantothenic acid (D-PA), is an essential in less nutrients that have a crucial importance in continuing the physical function of an organism [14]. It is utilized in various fields including edible things, medication, or others. Recently , the industrial manufacturing of D-pantothenic acid mostly depend on chemical processes and enzymatic catalysis. With highly marketed demand, shifting from chemical-based production of D-pantothenic acid to microbial fermentation utilizing renewable resources is essential [12]. (B5) Pantothenic acid is essential for coenzyme A formation and is also helpful for α-ketoglutarate and pyruvate dehydrogenase complexes also as fatty acid oxidation [3]. [12][13]. The structure of CoA acts as a carbonyl-activating group and serves as an acyl group carrier, facilitating these diverse reactions [14].

2.4.1 Adverse Effects:

Doses for Vitamin B5 vary depending on age and whether a female is pregnant or lactating. Intake exceeding 10 grams per day may lead to loose motions or intestinal ache [15].



2.4 chemical structure of pantothenic acid.

2.5 Vitamin B6 (Pyridoxin)

Vitamin B6 plays a vital role in a wide array of metabolic, physiological, and developmental processes within the body. Because of its solubility in water and also highly reactive when phosphorylated. vitamin B6 serves as a satisfactory co-factor for numerous biological and chemical processes [14]. Pyridoxal 5′-phosphate (PLP), the active form of Vitamin B6, acts as a co-factor in over 150 enzymatic reactions. Plasma pyridoxal 5′-phosphate (PLP) levels have usually found to be less in inflaming situations. There is also a reduction in liver PLP levels, although changes in erythrocyte and muscle PLP, as well as in functional vitamin B6 biomarkers, are less pronounced. Plasma pyridoxal 5′-phosphate (PLP) levels also predict the risk of long-term diseases such as cardiovascular disease and certain cancers. Pyridoxine stands out as a pivotal molecule crucial for maintaining the health and optimal functioning of the human body.

2.5 chemical structure of pyridoxine.

2.6 Vitamin B7 (Biotin)

Vitamin B7 (biotin), Biotin is additionally called vitamin B7, vitamin B8 or vitamin H. Biotin could be a dissolvable compound and appearance is colourless. It is Synthesise in bacterial stomach and also may have a importance [16]. Biotin (B7) acts as an antioxidant, hindering the effects of many free radicals that are naturally formed within the body [17].

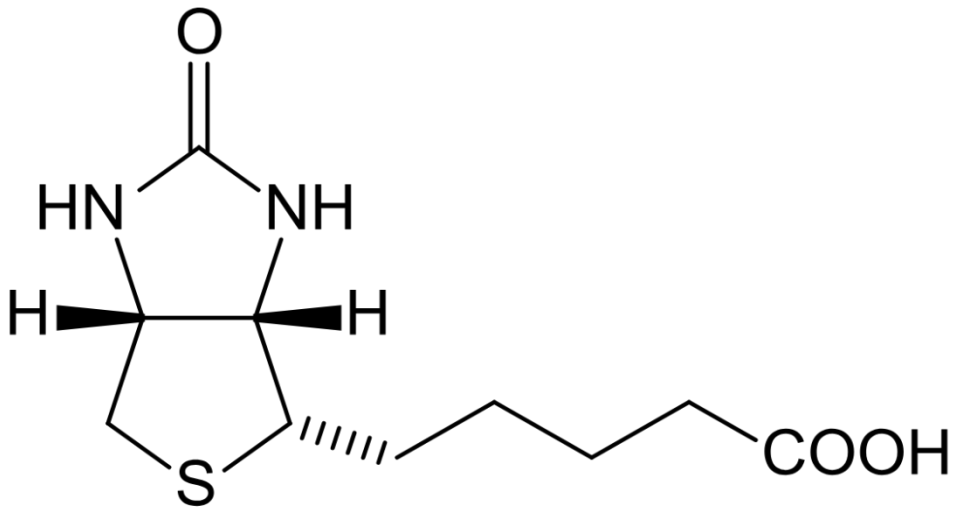
Biotin (vitamin B7) could be a cofactor for numerous essential cellular forms, serving as a CO2 carrier in biotin-dependent carboxylation responses. Carboxylation is a ubiquitous process that involves the fixation of CO2 into organic compounds, and as such, this process is acquired throughout all stages of life. These carboxylation reactions are critical for the synthesis and metabolism of fatty acids, amino acids, and carbohydrates [18] Biotin, an essential vitamin, plays a significant role in skin health, nerve function, and digestive system health. It also helps in deliver energy and in the fat metabolism, proteins. It is useful in the fetus growth [17]. Biotin shows broad functions. Insufficient concentrations of biotin may cause neurological diseases.

2.6.1 Administration

Biotin dose recommended range is from 5 µg to 35 µg per day, or according to need . as, if there is no daily recommendation for the general population, or biotin supplementation may be necessary for a breastfeeding mother because of increase nutritional demand.

The most commonly biotin is administered orally, but it can also be administered intravenously (IV) in cases of apparent and symptomatic biotin deficiency.

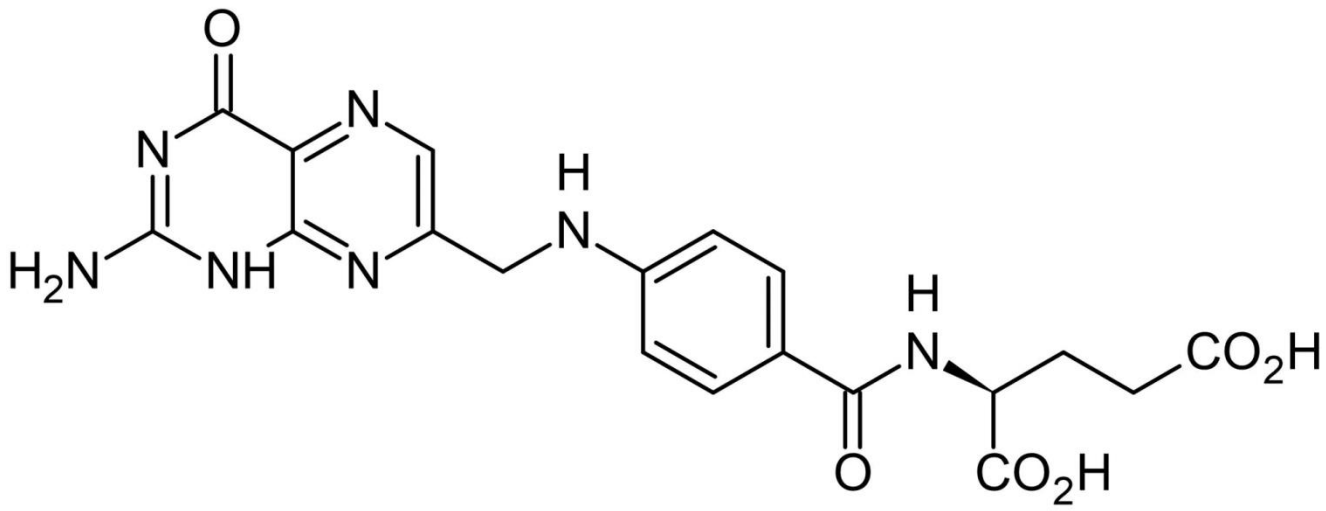
Tablet forms of biotin typically come in doses of 10 µg, 50 µg, or 100 µg. After metabolized by the liver it get excreted by kidneys.



2.6 chemical structure of Biotin.

2.7 Vitamin B9 (Folate)

Folate is crucial for various cellular processes, including growth of cell, metabolism of amino acid, and red and white blood cells formation. [18] A critical function of folic acid is also its contribution to the growth of the back bone and nervous system of fetus during pregnancy. Similar to other B vitamins, folic acid promotes energy production in the body. In the human body, the coenzymes of vitamin B9 (folate) participate in reactions with one-carbon units crucial for the metabolism of nucleic and amino acids.Folate is important for maintaining the vital activity of all cells.. The terms folate, folic acid, and vitamin B9 are also exchangeable. Although folate is naturally present in both food and the human body in a metabolically active form, folic acid is frequently used in vitamin supplements and fortified foods.



2.7 chemical structure of vitamin folate

2.8 Vitamin B12 (cobalamin)

The term vitamin B12 serves as a general classification for cobalamins, a group of compounds containing cobalt and characterized by the corrin ring structure, possessing the biological activity associated with vitamin functions. Vitamin active coenzyme forms are methyl cobalamin and de-oxy-adenosyl-cobalamin . Vitamin B12 is predominantly sourced from animal-derived foods as it is not naturally found in plant-based foods. Humans acquire limited amounts of vitamin B12 from their gut bacteria. This vitamin plays a critical role in DNA synthesis, the formation of nucleoproteins, erythropoiesis, myelin synthesis, normal growth, cell reproduction, and one-carbon metabolism, highlighting its indispensable importance in various physiological processes.

Dietary intake inadequacy can lead to a deficiency in Vitamin B12. It is involved in the isomerization of methyl malonyl-CoA to succinyl-CoA by methyl malonyl-CoA mutase and is also necessary for the change of homocysteine to methionine by methionine synthase. Strict vegetarians may experience dietary deficiency since the vitamin is primarily present in animal origin food or produced by microorganisms. The lack of cobalamin

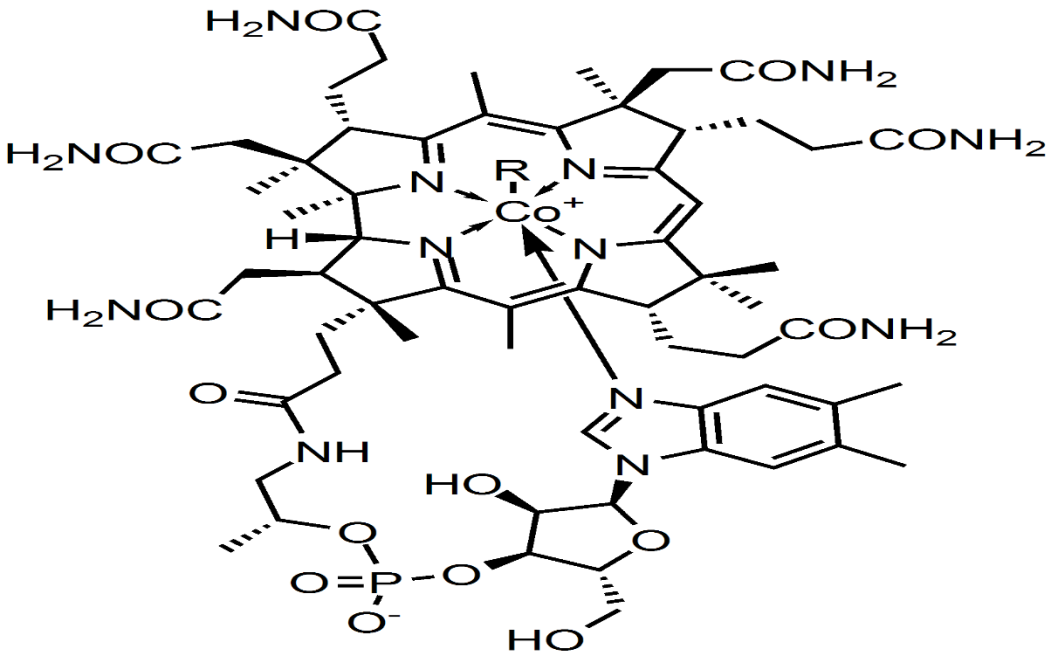
can lead to conditions such as carious types of anemia, methylmalonic aciduria, neuropathy, and folate trap. Vitamin B12 deficiency can significantly impact human health, causing severe and sometimes irreversible neurological damage, disorientation, nerve disorders, and other disorders. This deficiency is particularly common among vegetarians, who may need to incorporate vegan sources of Vitamin B12 into their diet. Early detection of Vitamin B12 deficiency is crucial for disease prevention and to convers any harm found. Cobalamin is primarily synthesized by microbes, as plants do not produce it.

2.8.1 TREATMENT/MANAGEMENT

In patients with decreased intrinsic factor, such as those with pernicious anemia or who have undergone gastric bypass surgery, orally cobalamin supplementation may not be absorbed completely because of deficiency of intrinsic factor. In such cases, a parenteral dose of B12 is given . A typical regimen involves administering 1000 mcg of B12 via intramuscular injection once a month.

2.8.2 Complications associated with vitamin B12 deficiency can be severe and wide-ranging:

1. Heart failure can result from the anemia caused by vitamin B12 deficiency.
2. Severe neurological deficits, which can be disabling, may occur if the deficiency is left untreated.
3. There is high risk of gastric cancer associated prolong use of vitamin B12 deficiency.



R = 5'-deoxyadenosyl, Me, OH, CN

2.8 chemical structure of vitamin B12(cobalamin)

s.no	Vitamin B	Main functions	Deficiency	Sources	RDI
1	B1 (Thiamin)	Conversion of protein, carbs, and fat from food into energy; nervous system function and synthesis of DNA.	. Fatigue . Nerve and brain damage . leads to beriberi	Cereal, spirulina, beans and Lentils, flax seed & other Seeds, milk, pork, nuts, oats Beef, rice, wheat.	Males:1-2mg/day. Females:1.1mg /day
2	B2(Riboflavin)	Converts protein, carbs, fat from food to energy; skin health and eye health	. cracks in the lips, tongue swelling, and other skin issues .leads to ariboflavinosis	Milk, dairy products, egg, Fish, green leafy veggies, Cereals, liver and whole Grains.	Males:1.3 mg/day Female:1.1 mg/day
3	B3(Niacin)	Converts carbohydrate to glucose to help body to producing different sex and stress- related hormones, plus promoting good circulation.	-Muscular weakness . loss of appetite .leads to pellagra	Yeast, milk, fish, seeds, eggs, green vegetables, beans, cereal grains, nuts, poultry.	Males:16mg/day Female:14mg/day
4	B5(pantothenica cid)	Production of red blood cells, healthy digestion, hormone production, converts carbs, fat from food into energy.	Fatigue Numbness Restlessness Anxiety Sleep disturbance	Fresh meat, vegetables and unprocessed grains. Found in juice about every food bur a good amount is lost when food is processed rather then fresh.	Males: 5mg/day Female: 5mg/day
5	B6(pyridoxin)	Acts in brain processes and development, immune system and steroid hormone activity. Protein and amino acid metabolism, released to stored glucose.	Impaired immune function. Irritability Dermatitis Muscle weakness Anxiety	Liver, meat, fish, poultry, Bananas, beans and cereal Also found in the same Food as B1 and B2.	Male:1.3-1.7mg/day Female:1.3-1.5mg/day

6	B7(Biotin)	Metabolizes protein, fats, carbohydrate and processes glucose. Also helps promote healthy hair, skin and nails.	Loss of appetite. Nervous system abnormalities. Deficiency of vitamin B7 is rare.	Egg, Nuts butter, Beans, Cauliflower, mushroom, Bananas, and the bacteria in intestine naturally produce enough to exceed body's daily requirement.	Male:30 mcg/day Female:30 mg/day
7	B9(folate)	Protein and amino acid metabolism, DNA synthesis, and formation of red blood cells. helps to develop the fetus nervous system and facilitate cell growth.	GI pain.Anemia. Deficiency in pregnant women will increase risk in the unborn baby, such as spina bifida.	Grains, beans, vegetables, Oranges, bananas, spinach, avocado, broccoli, asparagus.	Males:400 mcg/day Females: 400mg/day
8	B12(cobalamin)	Maintains the insulation around the nerve cells, mental ability and red blood cells formation, food metabolism and energy production.	Fatigue. Loss of appetite. Nerve damage. Anemia.	Liver, dairy product, yogurt, fish, oysters, and anything that comes from an animal will contain B12. Vegans need to supplement their diet with B12.	Males:2.4 mcg/day. Females:2.4 mg/day

Table 1: vitamin B functions, Deficiency, and Sources, RDI.

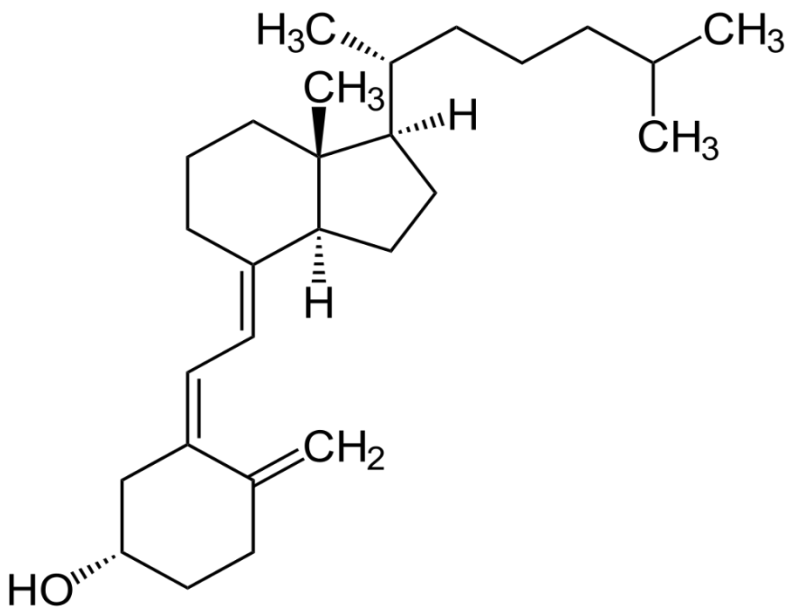
3.Vitamin D

Vitamin D, a fat-soluble vitamin, holds distinctive significance in bone metabolism due to its pivotal role in regulating calcium and phosphorus absorption, promoting mineralization, and maintaining bone density, helping to maintain bone health and density. vitamin D also exhibits anti-inflammatory and immune-modulating properties, contributing to overall immune system function and regulation. Vitamin D3, is known as cholecalciferol, which is formed in skin during exposure to sunlight, particularly ultraviolet (UV) light, in the summer months. It is also present in diet sources , especially fish. Once synthesized or ingested, vitamin D goes for hydroxylation in the liver, there it converts to 25-hydroxyvitamin D (25(OH)D), and then in the kidney, where it is converted to its active form, 1,25-dihydroxyvitamin D (1,25(OH)2D). This is active metabolite which can enter in cells, where it binds to the vitamin D receptor and interacts with responsive genes, such as those involved in the regulation of calcium-binding proteins. There are two primary forms of vitamin D: one is the vitamin D3, which is known as cholecalciferol, other one is vitamin D2, which is known as ergocalciferol. Vitamin D3 is synthesized in the skin by the sunlight exposure. particularly during the summer months, and also

present in well balanced diets, especially fatty fish like herring and mackerel. On the other hand, vitamin D2 is obtained from the irradiation of plants, plant materials, or fortified foods. The main difference between the two forms lies in their side chains. Severe deficiency of vitamin D may cause serious disease like rickets in children or osteomalacia in adults. In osteomalacia, there is an accumulation of unmineralized bone matrix, known as osteoid, which covers most surfaces of trabecular and cortical bone. This is distinct from osteoporosis, where there is a decrease in bone density but not the accumulation of osteoid.

3.1 Sources:

The primarily vitamin D is the synthesize as that occurs in the skin upon exposure to sunlight. However, people does not typically take regularly diet which contain vitamin D in sufficient amount. Therefore, supplementation may be necessary for individuals with less sun exposure or reduced cutaneous synthesis of vitamin D, particularly in older adults.The process begins with the synthesis of pre vitamin D3 from 7-dehydrocholesterol, a compound known as provitamin D, when the skin is exposed to ultraviolet rays from sunlight in the range of 290–320 nm. Previtamin D3 then undergoes a rearrangement of its molecular structure, converting into vitamin D3 or cholecalciferol.Exposure to ultraviolet radiation equivalent to about 25% of the minimum erythematous dose (MED) over approximately one-quarter of the skin surface, including areas like the face, hands, and arms, can produce approximately 1000 IU of vitamin D.Various component can influence the efficiency of this synthesis, including age, skin colour (melanin content), season, weather conditions, geographical latitude and altitude, time of day, clothing, the extent of skin surface exposed, vacation habits, sunscreen usage, and skin type. Aging, for instance, diminishes the skin's ability to synthesize vitamin D.



3.1 CHEMICAL STRUCTURE OF VITAMIN D(Cholecalciferol)