IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

A Review of Diseases Related to Magnesium and Vitamin B-complex Deficiency

[*]Mohamed Ali Jwaili
[*]Omar Mohamed Rwaiha
Aisha Abdullah Ahwidge
Fatima Muftah Almheshi

* Faculty of Pharmacy, Department of Pharmaceutical Care, Misurata University, Libya.

ABSTRACT

Vitamins and minerals are chemical molecules that our systems require in trace amounts for a range of metabolic functions. Basically, they keep us healthy and help our bodies function. Every second of the day, the body's cells undergo millions of chemical interactions. The cells are constantly processing the proteins, lipids, and carbs in food. Vitamins and minerals are key components of these chemical processes. They are required for the proper functioning of the organism. Vitamins and minerals have recently gained importance in clinical therapy and are now the preferred treatment for health complications.

This review aims to focus on the role of magnesium and vitamin B-complex in clinical health, and how its deficiency affects our body and causes serious problems and the importance of foods that include magnesium and B-complex. Magnesium and B vitamin-based nutritional supplement. It is advised in cases of decreased intake or increasing need for them. Magnesium helps to reduce weariness and tiredness by balancing electrolytes and energy levels. Magnesium and B vitamins help to maintain a healthy psychological and physical state, minimize exhaustion and fatigue, and regulate energy metabolism.

Keywords: *Magnesium, Deficiency, Vitamin, B-Complex, Food supplement, Food source.*

Magnesium is one of the seven essential macrominerals.[1] Magnesium is necessary for the construction of bones and teeth. Magnesium is an important mineral that influences over 300 enzyme processes in the human body, including ATP binding for kinase reactions, as well as the permeability of excitable membranes and neuromuscular transmission.[1,2] It has several roles including as helping with muscle and nerve function, regulating blood pressure, and boosting the immune system.[1] DNA replication, RNA, and protein synthesis.[3]

It also has a significant impact on plants and animals. Magnesium is the key ion of chlorophyll. In vertebrates, magnesium is the fourth most prevalent cation and is vital, especially within cells. It is the second most frequent intracellular cation after potassium. Both of these components are required for a variety of physiological processes. Magnesium is also employed in a variety of technical and medical applications, including alloy manufacture, pyrotechnics, fertilizers, and health care.[4] An adult body has around 25 grams (g) of magnesium, 50-60% of which is stored in the skeletal system. The remainder is found in muscle, soft tissues, and physiological fluids, amounting to at least 100 milligrams (mg) daily.[1]

1.1 Importance of Magnesium:

Magnesium works with other electrolytes like calcium, potassium, and sodium. Electrolytes are found in cells, body fluids, tissues, and bones and are essential because they balance water in the body, regulate the body's acid/base (pH) ratios, transport nutrients in and out of cells, and remove waste from cells.[5] Magnesium helps your brain and body communicate by relaying messages. It works as a gatekeeper for N-methyl-D-aspartate (NMDA) receptors, which are present on nerve cells and help with brain growth, memory, and learning. In healthy adults, magnesium resides inside the NMDA receptors, keeping them from being activated by weak impulses that could stimulate your nerve cells unduly.[6]

1.2 Magnesium homeostasis:

The absorption of magnesium in the gastrointestinal tract is not entirely understood, however saturable magnesium buildup processes have been discovered in the ileum's brush boundary cells. While magnesium is actively transported in the ileum, the rest of the small intestine absorbs it passively. Magnesium from the diet is absorbed at the apical side of intestinal epithelial cells before being released into the bloodstream via a Na+/Mg2+ exchange. 6 Magnesium reserves in the bones form an exchangeable pool that can be used to buffer variations in serum magnesium levels. Magnesium is also found in the bloodstream. Erythrocytes, and their magnesium concentration is considered an ideal indicator of the body has magnesium reserves. Renal control of these ions occurs via glomerular filtration and tubular reabsorption, and is a key factor in plasma ion concentration. Over the last several years, it has been discovered that the tight junction proteins claudin-10 and claudin-16 play a key role in the paracellular reabsorption of magnesium along the ascending limb of the Henle loop. Genetic studies in patients with primary hypomagnesaemia identified "transient receptor potential melastatin [6]" (TRPM6) as the major component involved in epithelial magnesium reabsorption.[7]

The kidney plays an important function in magnesium homeostasis. Typically, 84 mmol of magnesium is filtered daily, with around 80 mmol being reabsorbed (95%). This leads in a urine excretion rate of around 4 mmol/day. The kidneys are largely responsible for: magnesium excretion. Renal magnesium excretion appears to have a diurnal cycle, with the highest excretion occurring at night. The glomeruli filter around 2400 mg (99 mmol) of magnesium per day. In contrast to most other ions, the majority of reabsorption occurs in the thick

ascending limb of the loop of Henle, rather than the proximal tubule. Only 10-25% of magnesium reabsorption occurs in the proximal tubule by passive Para cellular transport.[8]

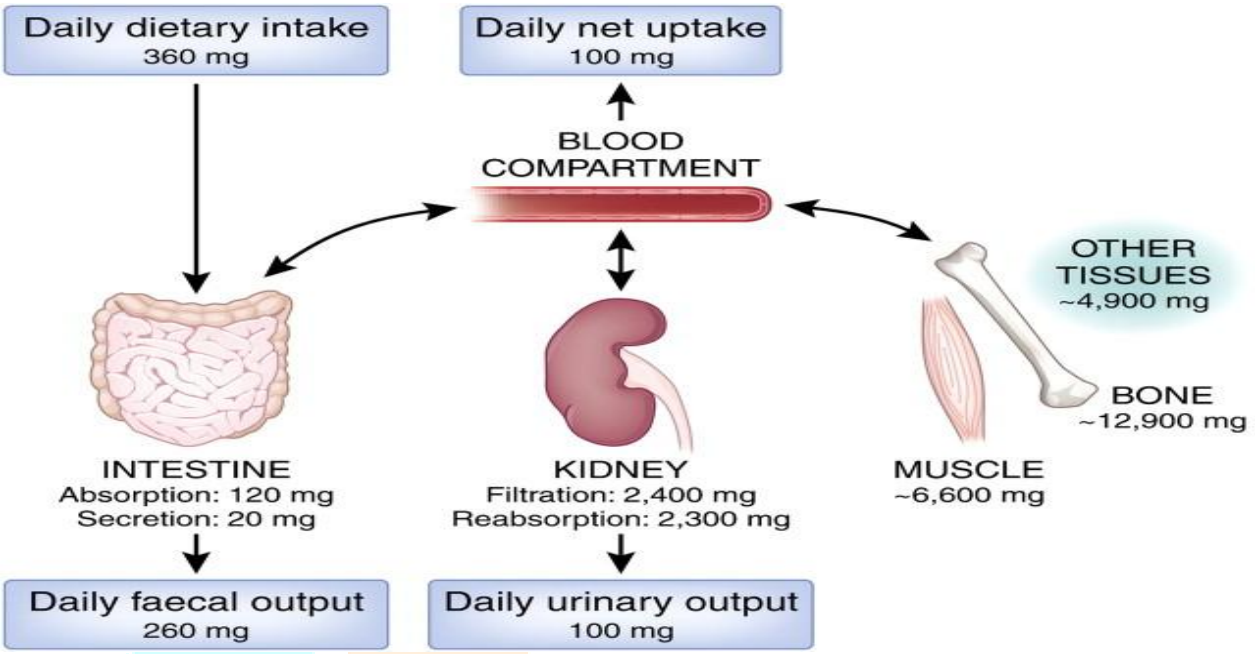

Fig 1: Magnesium homeostasis. [8]

1.3 Magnesium blood test:

Magnesium blood test detects the amount of magnesium in the blood. The majority of your body's magnesium is stored in bones and cells. However, only a little amount is present in blood. Magnesium levels in the blood can be abnormally low or excessive, indicating a major health risk.[9] abnormal magnesium levels may arise in circumstances that impair your body's function. [10] Other names include Mg, Mag, and Magnesium-Serum. A magnesium blood test is performed to determine the amount of magnesium in your bloodstream. Hypomagnesaemia, often known as magnesium deficiency, occurs when levels are excessively low. This is more common than abnormally high amounts, known as hypermagnesemia.[9] If you have symptoms, your doctor may perform a magnesium test. Or if you have diabetes or kidney problems. A blood test is the most common approach to determine your magnesium level. You may hear the term "total serum magnesium test."[11]

Procedure of Magnesium measurements:

A health care practitioner will use a tiny needle to draw blood from an arm vein. After the needle is inserted, a little amount of blood will be drawn into a test tube or vial. When the needle is inserted or removed, you may experience a mild sting. This normally takes under five minutes.[9] Magnesium test may be recommended as part of a series of tests if you experience symptoms such as nausea, weakness, twitching, cramps or confusion, diarrhea, slowing heart rate, upset stomach vomiting and cardiac arrhythmia. An erratic heartbeat.[10, 12] the normal serum magnesium level is 1.7 to 2.3 milligrams per deciliter. These standards can be influenced by age, health, body type, and gender. [13] Certain Medicines can have an effect on magnesium levels. Inform your healthcare practitioner about any prescription or over-the-counter medications you are using. Your doctor will tell you if you need to stop taking them for a few days before the test. You will also need to cease taking magnesium supplements before to your test.[9] Low magnesium levels in the blood indicate that the body is not obtaining enough magnesium from its diet, the intestines are not absorbing enough magnesium, and the kidneys are excreting too much.[14] People who have undergone recent surgery may have

low magnesium levels. Some people do not receive enough magnesium. A generally healthy person would not likely experience symptoms of magnesium deficiency unless it persisted for an extended period of time.[12] A magnesium test may be suggested as part of a series of tests if you have symptoms like:

Nausea and vomiting.

I have a poor appetite.

Sleepiness.

Extreme cases might result in uncontrollable muscle spasms and tremors.[12]

Tiredness.

Weight loss.

Seizures [13].

Other Magnesium Tests:

Some specialists believe a blood test is not the best approach to determine your magnesium level. This is because the majority of magnesium in your body is kept in your bones and other tissues rather than in your blood. Stress can cause magnesium to leave your cells and enter your bloodstream. This can make it appear that you have more magnesium in your body than you actually have if you merely get a blood test.

There are different tests: Several of them: Test the amount of magnesium you obtain. Get rid of in your pee. Check the magnesium level in your red blood cells (RBCs). Magnesium levels should be measured in your cells rather than in your blood. This test, known as the "EXA Test," is performed using a sample of your mouth cells. It is difficult to obtain this test because it is not widely known and is extremely pricey.[10]

2. Magnesium Deficit:

Magnesium deficit occurs when the body does not receive enough magnesium for optimal health. Health concerns associated with magnesium shortage are uncommon, however if your magnesium levels are low over time owing to other health conditions such as alcoholism or using certain medications[14], these drugs include: Hydrochlorothiazide and other diuretics are used to treat excessive blood pressure and cardiac problems, Antibiotics, like aminoglycosides. Chemotherapy drugs, such as Cisplatin® and Proton pump inhibitors such as pantoprazole.[15]

2.1 Disease-caused Magnesium deficiency:

The intestines absorb magnesium. Diseases of the gut can induce persistent diarrhea and fat malabsorption, resulting in magnesium depletion over time. This is especially true after a small intestine resection or bypass, particularly the ileum. Type 2 diabetes: Individuals with type 2 diabetes frequently have increased urine, which can lead to magnesium depletion. Chronic alcoholism can cause poor nutrition, gastrointestinal issues, kidney dysfunction, liver illness, and mineral loss, including phosphate and vitamin D. All of these factors may contribute to lower magnesium levels. Hungry bone syndrome: Following partial or complete thyroid ectomy surgery, the body may increasehow much magnesium it consumes, resulting in hungry bone syndrome, a state

of severe hypocalcemia. Pancreatitis: Sudden inflammation or swelling in the pancreas can result in malabsorption and nutritional deficiency, such as magnesium. Kidney disease: Diseases or illnesses that cause the kidneys to have difficulty controlling magnesium output might result in a deficit.[16]

2.2 Symptoms of Magnesium deficiency:

Magnesium insufficiency symptoms are sometimes nonspecific, leading medical practitioners to suspect other illnesses or deficits.[17] Early indications of insufficient magnesium include:

Nausea.[18] Loss of appetite[17]. Vomiting. Weakness.

As magnesium shortage progresses, symptoms may include: Numbness.[18] High blood pressure.[17] Muscle cramping.

Seizures.
Muscle spasticity.

Aberrant cardiac rhythm.[18]

Osteoporosis.
Asthma.[19]

Magnesium shortage may raise the likelihood of several more serious disorders over time:

Chronic Medical Conditions.

Psychiatric disorders.

Depressive disorder.

Type 2 diabetes.

Anxiety disorders.

Seizure.

ADH.

PMS.

Arrhythmia.

Cardiovascular illness.

High blood pressure.

Migraine headaches.

Osteoporosis.[20]

2.3 Magnesium-Deficiency Related Diseases:

Magnesium is the second most prevalent intracellular cation and plays a crucial role in various metabolic activities.[21] Magnesium is known to have antiarrhythmic properties and can affect blood pressure levels by altering vascular tone. Changes in extracellular magnesium level can influence the synthesis and release of nitric oxide (NO), altering arterial smooth muscle tone by influencing calcium concentrations. Magnesium also affects glucose metabolism and insulin balance. For these reasons, it has been proposed that magnesium depletion or alterations in its metabolism are linked to the pathogenesis of hypertension. Atherosclerosis, insulin resistance, and diabetes.[22] Increased extracellular magnesium levels prevent calcium influx. Conversely, low extracellular magnesium stimulates calcium influx via calcium channels. Low intracellular magnesium concentrations increase intracellular calcium mobilization via inositol-triphosphate (IP3) and decrease Ca2+-ATPase activity. Thus, calcium efflux and sarcoplasmic reticular calcium reuptake are diminished, resulting in calcium buildup in the cytosol and increased intracellular calcium concentration, both of which are important factors in vasoconstriction. Increased intracellular magnesium levels lead to lower intracellular free calcium concentrations, which promotes vasodilation.[23]Magnesium's activity as a calcium channel blocker may also aid to limit calcium release, hence lowering vascular resistance.[24] Furthermore, magnesium triggers the Na-K ATPase pump, which manages the balance of these minerals and contributes to electrolyte homeostasis cells. Lower magnesium concentrations appear to be connected with lower serum HDL cholesterol, as well as higher LDL cholesterol and triglyceride levels.[22] Furthermore, deficiency in this mineral has been linked to oxidative stress, proinflammatory state, endothelial dysfunction, platelet aggregation, insulin resistance, and hyperglycemia.[25]

2.3.1 Cardiovascular disorders:

Several studies have connected low magnesium levels with an increased risk of heart disease.[26] Low serum Magnesium is associated with inflammation and modulates various cardiac ion channels, including the calcium channel and outward potassium currents. Lowering the cytosolic magnesium concentration during magnesium depletion significantly increases these outward currents, shortening the action potential and increasing susceptibility to arrhythmias.[26, 27] these pathways are hypothesized to contribute to the development and progression of atherosclerosis, which may aggravate coronary heart disease (CHD). MagnesiumIt is also recognized for its role in the electrical stability and energy balance of cardiomyocytes. Low serum Magnesium can result in rapid cardiac death.[28] Magnesium may lower the risk of heart disease. One method involves its antioxidant and anti-inflammatory properties.[29]

2.3.2 Blood pressure:

Magnesium affects blood pressure regulation via altering vascular tone and responsiveness. The direct vascular impact of magnesium was first proposed in the early 1900s, when clinical research revealed that magnesium salt infusion decreases blood pressure by decreasing peripheral vascular resistance despite a minor increase in cardiac contractility. Experimental studies back up these clinical findings and indicate that acute magnesium treatment causes.[30] If you have high blood pressure, you should acquire magnesium from Instead of taking supplements or eating foods with added magnesium, consume foods that are naturally high in this crucial mineral.[31]

Magnesium helps reduce blood pressure in numerous ways, including relaxing blood vessels. Act as a natural calcium channel blocker. Increase nitric oxide levels while decreasing endothelial dysfunction, which is an imbalance between relaxing and contracting components in blood vessels. According to studies on magnesium supplementation, 300 mg/day is sufficient to considerably lower blood pressure.[32]

2.3.3 Diabetes

Magnesium is a necessary cofactor for enzymes involved in glucose metabolism. A substantial link between magnesium and insulin function has been found. In adults, reduced serum and intracellular magnesium concentrations are related with IR, impaired glucose tolerance, and decreased insulin secretion. [33] A deficit may occur with type 1 and type 2 diabetes, but it appears to be more prevalent in type 2. This is because low magnesium levels are linked to insulin resistance. People who are insulin sensitive or resistant lose extra magnesium in their urine, which contributes to low levels of this vitamin.[34] Increasing your magnesium intake has been proven to potentially reduce your risk of acquiring the chronic condition. According to research, eating 100 milligrams (mg) of magnesium-rich foods may reduce the incidence of diabetes by 15%.[35]

2.3.4 Mental Health

Magnesium is important for nerve transmission and neuromuscular conduction. It also protects neurons from excessive excitement, which can cause cell death (excitotoxicity) and has been linked to a variety of neurological diseases. Because of these critical activities in the nervous system, magnesium is a mineral of great interest for the potential prevention and treatment of neurological illnesses.[36] Magnesium can also help with symptoms of depression, anxiety, ADHD, and other mental health disorders such as: Increased levels of stress.[37] Insomnia or sleep difficulties; headaches or muscle pain/tightness/fatigue.[38]

Fatigue

Fatigue is sometimes the first and most obvious symptom of a magnesium shortage. Because it is such a wide symptom, many people fail to associate it with low magnesium.[37] Magnesium performs two key roles in the brain: it inhibits the activity of more stimulating neurotransmitters and binds to calming receptors, resulting in a more serene, resting state. Also helps to manage the release of stress hormones such as cortisol, which acts as a brake on your nervous system.[38]

Magnesium works in the brain to regulate the actions of N-methyl-D-aspartate (NMDA) glutamate receptors. These receptors are thought to play a crucial role in memory and learning.[39] Glutamate is an excitatory neurotransmitter essential for regular brain function. When consumed in excess, it can cause cell overstimulation, which can result in damage and cell death and has been associated to illnesses such as seizures, stroke, Parkinson's disease, multiple sclerosis, Alzheimer's disease, and amyotrophic lateral sclerosis. In addition to contributing to these neurological diseases, increased glutamate activation has been related to depression and anxiety.[39] One of the primary pathways that magnesium impacts is the glutamate receptor site1, which inhibits glutamate activation in NMDA receptors. Magnesium binds to receptor proteins on cell membranes, preventing glutamate from binding. This is what causes magnesium's antidepressant-like effects. Glutamate imbalance might worsen ADHD symptoms.[37]

Magnesium's antidepressant impact is most likely mediated by a variety of processes. The most important one appears to be the inhibition of the glutamatergic N-methyl-D-aspartate receptor (NMDAR), which is also the target of the fast-acting antidepressant ketamine. Another noteworthy discovery that supports the hypothesis of magnesium's antidepressant action is that linked Magnesium shortage leads to dysregulation in the hypothalamic-pituitary-adrenal (HPA) axis, which is well known to be involved in the etiology of anxiety and depression. Magnesium's antidepressant action appears to be, at least partially, mediated by a modulation of the serotoninergic system; in fact, it appears that magnesium has a synergistic effect when administered with molecules of the selective serotonin reuptake inhibitor (SSRI) class, and that the antidepressant action of magnesium is impaired when animals are pre-treated with a compound that inhibits serotonin synthesis.

Interestingly, in rats, a magnesium-deficient diet was found to be associated with changes in the gut microbiota, eventually leading to changes in the gut-brain axis and the development of depressive-like behaviors. Furthermore, there are other reports. Magnesium may play an important role in the efficacy of antipsychotic medicines. Both haloperidol and risperidone were found to raise intra-erythrocytic magnesium levels, and treatment of hyperparathyroidism-induced psychosis appears to be dependent on magnesium levels, with hypomagnesaemia producing treatment resistance to antipsychotics. Magnesium also appears to play a role in the prevention and reversal of movement abnormalities caused by long-term use of conventional antipsychotics. Furthermore, in an animal model, magnesium was found to lower the severity of movement abnormalities by inhibiting the generation of reactive oxygen species in cortical regions, striatum, and substantia nigra.[40]

Anxiety

it is taken in the morning for energy production and mood support, and again at night if you need further stress relief or relaxation before bedtime. This is especially effective if you have one or more caffeinated beverages throughout the day.[37]

Sleep

Magnesium also aids in the regulation of the sleep hormone melatonin, which is responsible for the circadian rhythm, or your natural sleep cycle. Your circadian clock affects a variety of functions, including feeling alert and then tired. If you're trying to improve your circadian rhythm, make sure your magnesium levels are ideal because they work together to help you get more rest. In one trial, supplementary magnesium reduced the time it took to fall asleep, increased overall sleep time, and reduced early-morning awakening in elderly people.[37]

Stress

Magnesium increases the body's ability to deal with stress. Magnesium has been shown to improve HPA axis control. Is a network of tissues that transmits stress signals from the brain to the body and vice versa. It works by helping your muscles relax and digest. Magnesium supplements have also been proven in studies to enhance glucose metabolism and lower blood pressure, both of which influence how effectively our bodies deal with stress.[37-38]

Migraine

According to studies, some migraine sufferers have insufficient magnesium levels. However, the precise role of magnesium in migraines is not fully established. Magnesium influences some of the receptors in the brain pathways that might cause headaches, including serotonin and N-methyl-D-aspartate (NMDA) receptors. One study found that magnesium supplementation improved migraine symptoms and decreased migraine frequency. However, this tendency was not statistically significant. While magnesium supplementation is not regarded the primary treatment for migraines, the Academy of Neurology and the American Headache Society both state that it is "probably effective" for migraine prevention.[41]

2.3.5 Osteoporosis.

Magnesium is an important ingredient for bone health and may thus be useful in the prevention of bone loss and osteoporosis.[42] Five ways a magnesium deficit may harm bone health:

Magnesium affects the types of cells (osteoblasts and osteoclasts) that the body requires for bone growth and repair. Magnesium shortage can directly impact bone by changing the shape and size of bone crystals. Magnesium deficits are associated with lower levels of parathyroid hormone (PTH) and the active form of vitamin D, both of which are important regulators of bone homeostasis. Magnesium deficiency is linked to an increase in inflammatory proteins (cytokines), which negatively impair bone remodeling. Magnesium shortages are connected with endothelial dysfunction, negatively influencing blood flow, which is required for bone health.

A magnesium deficit can reduce the body's buffering ability, resulting in low-grade acidosis. Metabolic

acidosis has been linked to calcium loss from bones and impaired bone mineralization.[43]

2.3.6 Gynecological Problems:

Magnesium, when taken daily, may help avoid dysmenorrhea (menstrual cramps) in some persons. It works by relaxing the smooth muscle of the uterus and lowering the prostaglandins that cause period pain,[44] which improves your menstrual cycle and overall health.[45] Magnesium supports the COMT enzyme (catechol-o-methyltransferase) in the liver, which promotes appropriate estrogen excretion.[46] This may lower the likelihood of estrogenic disorders (such as fibroids) linked with reduced COMT function.[47] Polycystic ovarian syndrome (PCOS) is a female endocrine condition associated with insulin resistance. If magnesium improves insulin resistance, it may be a valuable supplement.[48] Lowers blood sugar and normalizes insulin levels. Magnesium is so good in improving insulin sensitivity that it is referred to as "natural metformin." Healthy insulin sensitivity results in less sugar cravings and a better chance of reversing PCOS. Magnesium normalizes progesterone's action on the central nervous system, which helps to treat PMS, migraines, and perimenopause. Magnesium promotes thyroid health. It is necessary for the generation of thyroid hormones. It is also anti-inflammatory, which helps to reduce the autoimmune inflammation that causes most thyroid diseases. Other options for treating thyroid autoimmunity include avoiding gluten and taking selenium supplements. Magnesium fuels healthy mitochondria, which are essential for hormonal health since steroid hormones are produced in the mitochondria. Magnesium inhibits aging by limiting telomere shortening, decreasing oxidative stress, and increasing glutathione production.[49]

2.3.7 Pregnancy Issues:

Calf cramps and vague stomach ache are common complaints among pregnant women. These symptoms can be caused by magnesium insufficiency. Other magnesium shortage symptoms include severe palpitations and tiredness. All of them are not necessarily cause for concern, but you should pay attention to your body's signals and maybe get tested for magnesium insufficiency. If there is a severe magnesium deficit during pregnancy, a constricted womb cannot relax any longer. As a result, pains can cause early contractions, which can lead to preterm birth in catastrophic situations.[44]

Sleep: Adequate magnesium supports more restful sleep, which can be hard in later during pregnancy, women experience more physical discomfort.

Mood: Pregnancy and postpartum are tough times. Magnesium plays an important function in mood stability and is increasingly advised by psychiatrists before administering antidepressants and other pharmaceutical medications.

Cramps and Muscle Function: As a result of increased physical demands, many women feel cramping and pain in various parts of their bodies. According to research, enough magnesium reduces cramping and the severity of acute pain.

Constipation: Having a baby jams the intestinal tract, resulting in a variety of digestive disorders, including constipation. Adequate magnesium intake promotes smoother bowel motions in the morning. This is also important in the early days after childbirth, when hard bowel movements can be extremely uncomfortable.

Childbirth Complications: Studies have revealed that Magnesium supplementation during pregnancy can reduce the risk of developing certain issues such as chronic hypertension, preeclampsia, placental malfunction, early labor, and low birth weight. However, studies are sparse, and more research is needed in these areas.[50]

Magnesium during pregnancy: The link between hypertension and preeclampsia Preeclampsia is one of the leading causes of maternal and fetal morbidity and mortality, affecting around 5%-7% of all pregnancies. Low magnesium levels are associated with pregnancy-induced hypertension, the precursor to eclampsia, pregnancy-related toxemias, and full-blown eclampsia. I believe that low maternal magnesium is a vital clue to unlocking the puzzle of low birth weight.[51, 52] The precise mechanism of magnesium sulfate in preeclampsia/eclampsia is uncertain, however various suggestions have beenproposed. To begin, magnesium causes vasodilation through calcium antagonism, which reduces myosin contractility and promotes tunica medium relaxation. It may also work indirectly by causing gestationally dependent synthesis of nitrous oxide, a strong vasodilator, and inhibiting endothelial platelet aggregation via prostaglandin I2. Reducing cerebral vasospasm may also help to prevent eclampsia caused by hypertension and oedema, as well as reduce cerebral ischaemic damage.[53]

Furthermore, magnesium sulphate may directly reduce cerebral oedema. Calcium antagonism reduces blood-brain barrier permeability by decreasing endothelial cell contraction, restricting pinocytosis, and inhibiting astrocyte aquaporin expression. Magnesium may also inhibit NMDA (N-methyl-D-asparate) receptors, which reduces central glutamic activation and prevents seizure activity. Furthermore, magnesium sulfate inhibits neuromuscular junction communication, potentially reducing outward signs of seizure activity.[53] Magnesium can assist to prevent period pain.[54]

3. Types of Magnesium:

Each form of magnesium salt has unique features. They can differ in terms of medical use, bioavailability (how easily the body absorbs them), and potential side effects.[55]

Magnesium citrate:
A very common kind of magnesium used to prevent and cure magnesium shortage, possibly because it is cheap and rapidly absorbed. It is primarily used to boost magnesium levels and alleviate constipation. [56, 57]
Magnesium Glycinate:
This form of magnesium is especially praised for its ability to reduce stress and anxiety and improve sleep.[56]
Magnesium Oxide:
Is commonly used to treat digestive issues such as heartburn and constipation. Given that the body does not absorb it efficiently, it is not a viable option for individuals who need to raise their magnesium levels.[58]
Magnesium Chloride:
It is easily absorbed orally and is used to treat heartburn and constipation. Using it topically may assist reduce muscle tightness but will not increase your magnesium levels.[58]
Magnesium Taurate:
Is the ideal choice of magnesium supplement for persons with cardiovascular disorders, because it is known to prevent arrhythmias and protect the heart from damage caused by heart attacks. Magnesium taurate is easily absorbed (magnesium and taurine maintain cell membranes) and has no laxative qualities.[57]
Magnesium sulfate:
Can be consumed as an oral supplement. Supplementation with this form of magnesium may be used to prevent and cure magnesium deficiency and constipation. (Injected) to prevent and treat seizures in women with preeclampsia (a kind of high blood pressure). Pregnancy can cause eclampsia (seizures caused by high blood pressure).[56]
Magnesium L-Threonate:
Is known to have a high bioavailability. This form enables magnesium to easily cross through the blood-brain barrier. It promotes brain health, which may benefit in the treatment of illnesses like as depression and memory loss.[56, 58]
Magnesium Orotate:

It is easily absorbed and does not have the powerful laxative effects that make it popular among competitive athletes and fitness enthusiasts, but it may also benefit those with heart problems by boosting energy production in the heart and blood vessel tissue.[58]

Magnesium Carbonate:

Magnesium carbonate is another popular, accessible form of magnesium that, when combined with hydrochloric acid in our stomachs, produces magnesium chloride. It is good. It is a good choice for persons who suffer from indigestion and acid reflux because it contains antacids.[57]

Magnesium Glutamate and Aspartate:

Avoid both of these magnesium types totally. Glutamic acid and aspartic acid are components of aspartame, a hazardous artificial sweetener that becomes neurotoxic when unbound to other amino acids.[57]

It is important while selecting magnesium products, it is crucial to examine how much magnesium a person already eats in their diet, whether a supplement or topical product is required, how much additional magnesium a person requires, and the optimal mode of administration, oral or topical.[55]

4. Magnesium poisoning (hypermagnesemia):

Hypermagnesemia is defined as a serum magnesium content of more than 2.6 mg/dL (1.05 mmol/L). The main cause is renal failure. Symptoms include hypotension and respiratory Depression and cardiac arrest. Serum magnesium concentrations are used to make the diagnosis. IV calcium gluconate treatment and, in severe situations, furosemide hemodialysis may be beneficial.[59] If the body absorbs too much magnesium, a person may experience any of the following symptoms, which can range from moderate to severe:

Lethargy.

Face flushing.

Diarrhea.

Nausea.

Stomach cramps.

Vomiting.

Depression.

Muscular weakness.

An erratic heartbeat.

Low blood pressure.

Urinary retention.

Breathing difficulty.

Cardiovascular arrest.[60]

4.1 Treatment for Hypermagnesemia:

Calcium Gluconate. Diuresis or dialysis.

Severe magnesium toxicity is treated with circulatory and respiratory support, as well as the intravenous infusion of 10% calcium gluconate (10 to 20 mL). Calcium gluconate may restore several of the magnesium-induced alterations, including respiratory depression. The administration of IV furosemide when renal function is acceptable, enhance magnesium excretion while maintaining volume status. Hemodialysis may be beneficial in severe hypermagnesemia because a significant portion (about 70%) of blood magnesium is not protein bound and so can be removed with hemodialysis. When hemodynamic compromise arises and hemodialysis is not feasible, peritoneal dialysis is an option.[59]

5. Magnesium sources:

Magnesium can be found in a variety of foods, particularly those high in fiber. The greatest sources are nuts, leafy greens, legumes, and whole grains. Magnesium-rich foods include almonds, spinach, cashews, peanuts, wheat cereal or bread, soy milk, and black beans.[61]

Vitamin B complex is a combination of molecules that are responsible for delivering energy to every cell in the body and formation. New building compounds, metabolism, and nervous system activity. The number of processes involving B complex vitamins is difficult to estimate.[62] In addition to energy metabolism, B vitamins are essential for DNA synthesis. This refers to the process of producing new cells, both reproductive (such as sperm and eggs) and non-reproductive (such as those found in our organs and tissues). Vitamin B complex is essential for the creation of nucleotides, which are the building blocks of DNA. Without adequate vitamin B complex, our cells would be unable to produce new DNA, resulting in a number of health concerns.[63] Vitamin B Complex contains: Vitamin B1: thiamine, B2: riboflavin, B3: niacin, B5: Pantothenic acid, Vitamin B6 (Pyridoxine), Vitamin B7 (Biotin), Vitamin B9 (Folate), and Vitamin B12 (Cobalamin).

Vitamin B complex advantages: This vitamin combination is essential for:
Neurodevelopment and brain function. Hormone production associated with sex and stress.
Healthy immune system function.
Healthy skin, hair, nails, and eyes.
Normal nervous system function.
Cells grow and evolve.
Red blood cell production.
A healthy digestive tract.
Energy production.
Liver function. [64]

1.2 Vitamin B insufficiency.

Certain groups, such as the elderly and pregnant women, are especially susceptible to vitamin B deficiency. They require higher levels of certain forms of vitamin B. Certain illnesses, such as Crohn's disease, Celiac disease, HIV, and alcohol use disorder, might impair the body's ability to absorb B vitamins, raising the risk of shortages. The symptoms of a vitamin B shortage differ depending on the B vitamin you lack. They can range from exhaustion and bewilderment to anaemia or a weakened immune system. Skin rashes might also

occur.[65]

2. Types of Vitamin B Complex:

2.1 Thiamine (Vitamin B1):

Vitamin B1, often known as thiamine or thiamin, is one of the B vitamins. All B vitamins assist the body turn food (carbohydrates) into fuel (glucose), which it then uses to generate energy.[66] Thiamin plays a crucial role in numerous body processes, including cell growth and function. Thiamin is also used by our bodies to turn foods into energy and to maintain our brains and neurological systems functioning normally. Thiamin insufficiency is uncommon in affluent countries, as most people dietary sources of this vitamin provide the necessary levels. It primarily affects cultures whose diets are deficient in this vitamin.[67]

Signs of Thiamine deficiency:

Thiamine deficiency likely to have one or more of the following symptoms:
Ataxia.
Confusion.
Nystagmus.
Irritability.
Seizure.
Papilledema.
Short-term memory loss.
Tachycardia.
Mood shifts.
Edema.
Dyspnea.

Possible Complications of Thiamine Deficiency: Left untreated, especially if a thiamine shortage is urgent, complications can be serious:

Deterioration in the heart's ability to pump blood.
Coma.
Neurological disease.
Heart failure.
Permanent nerve injury can restrict feeling.
Psychosis.
Diabetic nerve damage is worsening.[68]
Food sources include salmon, flax seed, navy beans, green peas, brown rice, and mussels.[69]

2.2 Vitamin B2 (riboflavin):

The Key Vitamin B2 functions in your cells by converting riboflavin into Flavin mononucleotide (FMN), which is subsequently turned into Flavin adenine dinucleotide (FAD). In addition, energy-producing enzymes use these two molecules as cofactors. Essentially, FMN and FAD accelerate chemical reactions in the energy production process. FMN and FAD also function as coenzymes. This means they bind to enzymes and activate

them, resulting in energy-producing processes. So without riboflavin, there is no FMN or FAD. Without FMN and FAD, your cells will struggle to produce energy. This alone is cause to ensure that you are getting enough riboflavin and that your gut is healthy enough to process and absorb it. But the benefits of riboflavin don't end there. Evidence suggests Riboflavin increases the action of powerful antioxidant enzymes that protect your cells from damage, malfunction, and disease. In reality, research have shown that taking riboflavin lessens the incidence of cardiac problems by enhancing antioxidant activity and reducing one's lipid profile. It has also been found to prevent cellular damage caused by strokes and brain traumas, as well as diabetic problems due to inflammation and oxidative stress. Furthermore, its antioxidant properties may contribute to its capacity to help prevent migraine headaches and protect cells from malaria infections. Riboflavin also plays a crucial part in your immune system. It promotes the formation of immune cells and mobilizes them to combat foreign invaders. Similarly, animals. According to research, it helps to reduce inflammation produced by immunological reactions.[70]

Signs of Vitamin B2 Deficiency:
A riboflavin deficit is quite rare. Thyroid disorders can increase the risk of deficiency. Riboflavin shortage is most commonly associated with other dietary deficiencies, such as malnutrition. Riboflavin deficiency can be diagnosed through a treatment trial or laboratory testing, which is often done by detecting riboflavin excretion in the urine.[72] Symptoms may include cracked lips, sore throat, mouth and throat swelling, swollen tongue (glossitis), hair loss, skin rash, anemia, itchy red eyes, and, in extreme cases, cataracts.[71]

Treatment for Riboflavin deficiency:
Oral riboflavin and other water-soluble vitamins. Riboflavin 5 to 10 mg orally once per day is administered till recovery. Other water soluble Vitamins should also be provided.[72] Food sources include beef liver, soybeans, eggs, fish eggs, Greek yogurt, white button mushrooms, and mussels.[73]
2.3 Niacin (vitamin B3):
Vitamin B-3, or niacin, is one of eight B vitamins. It helps turn the food we eat into energy. It aids the body's use of proteins and lipids while also promoting the health of the skin, hair, and neurological system. Other possible benefits of vitamin B-3 include cholesterol-lowering, antioxidant, and anti-inflammatory effects. Vitamin B-3 is also known as nicotinamide, nicotinic acid, and vitamin PP since it helps prevent pellagra. The body excretes any niacin that it does not require in urine. Niacin cannot be stored in the body, thus it must be consumed through food every day.[74]

Signs of vitamin B3 insufficiency: A severe deficit known as pellagra can produce symptoms in the skin, digestive system, and nervous system. They include a thick, scaly pigmented rash on skin exposed to sunlight. Swollen mouth, bright red tongue, Vomiting and diarrhea. Headache, apathy, fatigue, depression, disorientation, and memory loss.

Niacin Deficiency Treatment: The recommended daily amount (RDA) for niacin is 16 milligrams for men and 14 mg for women.[75] Source of food: Red meats include beef, beef liver, pork, poultry, fish, brown rice, fortified cereals and breads, nuts, seeds, legumes, and bananas. [76]

2.4 Vitamin B5 (Pantothenic Acid)
Vitamin B5, also known as pantothenic acid, is found naturally in foods, can be added to them, and is available as a supplement. It is used to make coenzyme A (CoA), a chemical compound that helps enzymes build and break down fatty acids as well as perform other metabolic functions, and acyl carrier protein, which is also involved in fat building,[77] supports healthy hair, skin, and nails, nurtures your liver, synthesizes cholesterol, and keeps your nervous system healthy,[78] It also contributes to the conversion of many other B vitamins into forms that the body can use, as well as an antioxidant and a neural component that aids in the enhancement of the immune system and neurological processes. It also helps to metabolize fat and reduce stress levels. Vitamin B5 is particularly beneficial in treating allergies, alcoholism, alopecia, autism, burning feet syndrome, yeast

infections, heart failure, and carpal tunnel syndrome. Conjunctivitis, respiratory diseases, asthma, attention deficit hyperactivity disorder (ADHD), celiac disease, colitis, convulsions, and cystitis.[79]

Vitamin B5 Uses:

Vitamin B5 has numerous health benefits, including the treatment of asthma, allergies, respiratory and cardiac problems, stress, anxiety, and depression. Vitamin B5 is well known for boosting immunity, relieving osteoarthritis pain, delaying the onset of aging, promoting growth, and preventing infections.[79]

Cosmetic Use:

Dexpanthenol, a vitamin B5-derived molecule, is found in a wide range of cosmetics and hair treatments. This water-soluble nutrient is well-known for improving skin texture, complexion, and tone, as well as making hair more glossy and voluminous.[79]

Symptoms of a vitamin B5 shortage include headaches, exhaustion, irritability, restless sleep, and numb or burning feet.[80] Tiredness, depression, sleep problems, stomach Symptoms include discomfort, nausea, vomiting, numbness, muscle cramps, hypoglycemia, burned feet, and upper respiratory infections. Pantothenic acid is present in practically all plant and animal diets to some extent, as the vitamin is found in all living cells.

Sources include:

Meat options include turkey, duck, and beef.

Fish include salmon, lobster, and shellfish.

Grains include whole grain breads and cereals. Whole grains are rich in vitamin B5.

Dairy items include egg yolks, milk, yogurt, and milk products.

Sunflower Seeds.[81]

Vegetables include mushrooms, avocados, broccoli, sweet potatoes, corn, cauliflower, kale, and tomatoes.[80]

Chicken Liver. [81]

2.5 Pyridoxine (Vitamin B6):

Vitamin B6 helps the central nervous system and metabolism. Its tasks include converting food into energy and assisting in the production of neurotransmitters, such as Serotonin and dopamine. This vitamin is also used for immune system function, brain development during pregnancy and infancy, Creating neurotransmitters like serotonin and dopamine, Creating hemoglobin, a component of red blood cells that transports oxygen, and maintaining brain function.[82] Several types of study indicate that vitamin B6 is critical for treating cardiac difficulties, alcohol addiction, cataract, glaucoma, diabetic pain, cerebellar syndrome (a type of brain damage), canker sores, motion sickness, kidney illness, AIDS, and menstruation disorders. Vitamin B6 is commonly eaten to promote immunity, improve athletic performance and muscle strength, and prevent kidney disease in type 2 diabetics and cervical cancer.[83]

Vitamin B6 is a strong antioxidant, therefore it helps scavenge damaging free radicals from the body, avoiding oxidative damage. It also rejuvenates the skin and eliminates age-related indications such as wrinkles, fine lines, spots, and dark circles. It is essential for the treatment and prevention of Alzheimer's disease and dementia. Its critical involvement in neurotransmitter production aids the brain in regulating mood swings while also preventing sadness, anxiety, pain, and weariness. It also stimulates the production of progesterone and regulates hormonal balance.[84]

Vitamin B6 Uses during Pregnancy:

Vitamin B6 is essential for your baby's developing brain and nerve system. Vitamin B6 also aids your baby's digestion of protein and carbohydrates. It is also crucial to you. Vitamin B6 aids in the synthesis of new red blood cells, antibodies, and neurotransmitters, as well as the metabolism of protein and carbs. You should be. You can get all of the vitamin B6 you need during pregnancy from a variety of foods and prenatal supplements, which typically contain at least 100% of the required amount.[85] If you are pregnant and experiencing morning

sickness, see your doctor before taking any additional B6 pills. Your provider can advise you on how much to take. (Do not exceed the dosage recommended by your provider). Too much vitamin B6 may be harmful to you or your growing baby.[85]

Morning sickness

Some treatments and supplements may be beneficial when you are sick and do not have time to rest. Morning sickness can have a negative impact on family and work time, and soda crackers and other non-medication cures are not always effective. Cut it. Taking vitamin B6 can help alleviate nausea sensations, but it may not significantly reduce vomiting.[86]

Benefits of Vitamin B6:

Vitamin B6 improves mood and is used to treat depression. This vitamin is necessary for the production of neurotransmitters such as serotonin, dopamine, and gamma-aminobutyric acid (GABA), which regulate emotions and help the body cope with stress. Vitamin B 6 is also good at lowering blood homocysteine levels, which are linked to depression. Furthermore, this vitamin aids in the secretion of melatonin, which is required to maintain circadian rhythm and promote restful sleep. Vitamin B6 improves brain function and reduces the risk of Alzheimer's via lowering homocysteine levels, which have been linked to impaired cognition and dementia. It is also necessary for healthy brain development in children.[83]

Maintain Healthy Blood Cells: Haemoglobin, a protein, provides oxygen and nutrition to all of the body's critical organs. When the hemoglobin count drops, the cells do not obtain enough oxygen, resulting in anemia. Vitamin B6 is primarily involved in hemoglobin synthesis and can help prevent and treat iron deficient anaemia.[83]

Vitamin B6 Deficiency:

vitamin B6 deficit is usually caused by a lack of other B vitamins in the body, particularly vitamin B12 and folic acid. A slight deficit may not produce any symptoms, while a more severe or sustained deficiency can cause the following:

Microcytic anemia.
Skin conditions.
Depression.
Confusion.
Reduced immunity.

Kidney disease, autoimmune intestinal disorders such as celiac, ulcerative colitis, and Crohn's disease, autoimmune inflammatory disorders such as rheumatoid arthritis, and alcoholism can all increase the risk of developing a deficiency by interfering with vitamin B6 absorption. Food sources include breakfast cereals, salmon, ground beef, cottage cheese, rice, onion, spinach, and watermelon.[86]

2.6 Biotin (vitamin B7)

Biotin helps enzymes break down lipids, carbs, and proteins in diet. It also serves to regulate cell signaling and gene activity.[87]

Benefits of Vitamin B7:

Many people take biotin supplements to improve the condition of their skin, hair, and nails. While additional research is needed, it appears that B7 may be beneficial. In these areas.[88] Biotin is essential for hair, skin, and nails. "Low levels of biotin can lead to brittle nails and thinning hair". There is some evidence that taking

biotin pills might help prevent hair loss, particularly if you are insufficient. Taking a biotin supplement is unlikely to cause harm and may improve hair quality. B7 may also aid in the treatment of diabetes. High dosages of biotin have also been shown to help treat peripheral neuropathy, a diabetes condition.[88]

Vitamin B7 Deficiency:

Biotin deficiency is unusual. Daily requirements are minimal, biotin-rich foods are plentiful, and the body efficiently recycles much of the biotin it has already consumed. However, long-term usage of some anti-seizure drugs, prolonged oral antibiotic use, and Biotin deficiency can result from intestinal malabsorption, intravenous feeding, and a regular consumption of raw egg whites.

Symptoms of biotin deficiency are:

Seborrhea dermatitis.

Dry skin, brittle hair, or hair loss.

Fatigue.

Issues with the intestinal tract.

Muscle ache.

Nervous system difficulties.[89]

Food sources include beef liver, salmon, avocado, eggs, nuts, and sweet potatoes.[87]

2.7 Folic Acid (vitamin B9):

Vitamin B9, often known as folate or folic acid in layman's words, is one of the eight water-soluble vitamins. Folate is derived from the Latin word folium, which means 'leaf', because it is mostly found in leafy plants and vegetables. Like most B vitamins, it is needed to transform food (carbohydrates) into simpler, easier-to-digest forms, such as glucose, which is required for energy production. Apart from Folic acid is essential for normal brain function and promoting mental and emotional wellbeing.[90] Folic acid is essential for brain function and contributes significantly to mental and emotional well-being. It aids in the creation of DNA and RNA, the body's genetic material, and is especially crucial during periods of fast cell and tissue growth, such as infancy, adolescence, and pregnancy. Folic acid also collaborates with vitamin B12 to help produce red blood cells and regulate iron levels in the body. Vitamin B9, together with vitamins B6, B12, and other minerals, regulates blood levels of the amino acid homocysteine. High amounts of homocysteine are related with heart disease, but researchers remain unsure. Whether homocysteine is a cause of heart disease or simply an indication that someone may have the condition.[91] Pregnant women should consume folic acid-rich foods or supplements because they help prevent the fetus from having significant congenital malformations of the brain or spine, including neural tube defects such as spina bifida and anencephaly. Vitamin B9 can help reduce the incidence of congenital heart malformations, cleft lip and palate deformities, and other anomalies during the preconception period. As a result, taking vitamin B9 before becoming pregnant can help prevent certain problems in the fetus. It also helps to prevent unexpected miscarriages.[90]

Vitamin B9 Deficiency:

Extreme weariness is one of the earliest indications of folate insufficiency. Other Symptoms Anemia symptoms may include paleness, shortness of breath (dyspnea), irritability, and dizziness. Common oral symptoms include painful, red tongue, mouth sores or ulcers, and impaired taste. Neurological symptoms include memory loss, difficulty concentrating, confusion, and problems with judgment. Additional signs of folate insufficiency may include fatigue, muscle weakness, depression, weight loss, and diarrhea.[92]

the risk factors for folate insufficiency are:

Malnutrition is defined as failing to consume a balanced diet rich in fruits, vegetables, and fortified foods.

Alcoholism or the consumption of high amounts of alcohol on a regular basis.

A lady of childbearing age.

Being pregnant.

Taking some medications, such as methotrexate, anti-seizure medications, and several ulcerative colitis treatments.[93]

Food sources include leafy green vegetables such as spinach, kale, broccoli, beans, peas, and lentils, eggs, shellfish, oranges. Whole grain and avocado. [94]

2.8 Vitamin B12 (cobalamin):

Vitamin B12 is an important B-vitamin. It is essential for nerve tissue health, brain function, and the synthesis of red blood cells. Cobalamin is an alternative name for vitamin B12. Vitamin B12 is the largest and most structurally complex vitamin.[95] Vitamin B12 is essential for a variety of bodily processes, including normal brain, nervous system, and cognitive functioning (thinking ability), red blood cell formation and anemia prevention, possibly preventing congenital abnormalities, protecting the eyes from macular degeneration, and energy production.[95] Vitamin B12 is particularly vital for maintaining healthy nerve cells and aiding in the creation of DNA and RNA, the body's genetic material. Vitamin B12 works closely and contains vitamin B9, also known as folate or folic acid, which aids in the production of red blood cells and improves iron absorption in the body. Folate and B12 interact together to form S-adenosylmethionine (SAMe), a molecule that affects immune function and mood. Vitamins B12, B6, and B9 work together to regulate blood levels of the amino acid homocysteine. High amounts of homocysteine are linked to heart disease. However, researchers are unsure if homocysteine is a cause of heart disease or simply a sign that suggests someone may have it.[96]

2.9 Application of Vitamin B12 in Clinical Health:

Pregnancy Health If a woman has a vitamin B12 deficit in the early stages of pregnancy, her child is at a greater risk of neural tube birth. Defects and low birth weight. Mothers with low B12 levels are also more prone to miscarry or deliver prematurely. Women with low vitamin B12 levels have a threefold increased risk of having a child with birth abnormalities.

Brain Health

Vitamin B12 is required for the neurons in the brain. Brain atrophy, or the loss of neurons in the brain, is linked to memory loss and dementia.[97]

Vitamin B12's Relation to Anemia:

Pernicious anemia.

An autoimmune reaction occurs when the body's immune system targets the stomach's parietal cells. These cells produce a glycoprotein known as intrinsic factor into the stomach cavity, which is required to absorb vitamin B12 from the meal. Without this component, Vitamin B12 is excreted of the body. Pernicious anemia creates a vitamin B12 shortage.

Macrocytic and megaloblastic anemia when the body lacks vitamin B12. It can create unusually big red blood cells, known as macrocytes that do not function correctly. Megaloblastic anemia is the most common cause of macrocytic anemia, and it is caused by a decrease in DNA synthesis. When red blood cells are not operating properly, hemoglobin is unable to attach to oxygen effectively. As a result, numerous tissues throughout the body do not receive adequate oxygen to maintain proper metabolism. This is called hypoxia, and it can cause cell death. Vitamin B-12 deficiency can also impede DNA synthesis, however RNA synthesis continues regardless of whether it is turned into DNA. This creates a lot of Build-up of genetic material within red blood cells, resulting in aberrant size and lack of function.[98]

Vitamin B12 Deficiency:

Vitamin deficiency anemia is characterized by a loss of healthy red blood cells due to insufficient vitamin B-12 and Folate levels. This can occur if you do not consume enough foods rich in vitamin B-12 and Folate, or if your body has difficulty absorbing or processing these vitamins. Without these nutrients, the body generates abnormally big red blood cells that do not function properly. This decreases their capacity to carry oxygen.

Symptoms may include weariness, shortness of breath, and dizziness. Vitamin supplements, whether given as pills or injections, can help to address deficiencies.[99]

Vitamin deficiency anemia normally develops slowly over several months or years. These symptoms may be mild at first, but they usually worsen as the shortage progresses. These can include fatigue, shortness of breath, dizziness, pale or yellowish skin. Irregular heartbeat, weight loss, numbness or tingling in the hands and feet, muscle weakness, personality changes, and erratic movements. Food sources include meat, eggs, milk, breakfast cereals, and nutritional yeast products.99 Recommended dosages: The recommended daily intake (RDI) of vitamin B12 for persons over 14 is 2.4 mcg.[100]

3. Conclusion.

Magnesium and vitamin B Complex are incredibly important in our bodies and perform a wide range of tasks in various organs and systems. Levels check and consultation with a doctor about taking magnesium and vitamin B Complex supplements, as well as the sort of supplements to use. People with kidney illness, heart disease, pregnancy, and breastfeeding should seek medical counsel before taking magnesium and vitamin B complex supplements. If you are presently taking any drugs, talk with your doctor and pharmacist before incorporating these supplements into your daily routine to avoid drug interactions and to raise awareness on how important minerals and vitamins are to our health and well-being.

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