

THE TRUTH ABOUT B-VITAMINS

EXPLORING A COMPLEX TOPIC



FUNCTIONS
SOURCES
DEFICIENCIES

THE TRUTH SERIES



THE TRUTH SERIES

As a discerning user of natural health products, you want what is best for your health. However, misinformation and deceptive marketing often make it challenging to identify fact from fiction. The Truth Series was created by Advanced Orthomolecular Research (AOR) to share the evidence-based truth about the most controversial and confusing topics within the natural health industry. At AOR, we believe that truth and transparency are the most important values for any organization to uphold. As visionaries, we are committed to continuous innovation so that we can advance the world of natural health. As such, the Truth Series aligns with our vision of providing optimal products without compromise.

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MAKING SENSE OF B VITAMINS

What Are They? Why Are They Important?

BY RANDALL HEILIK

B vitamins are a class of water (as opposed to fat) soluble vitamins which play an essential role in many cellular processes. They are often called "the energy vitamins," but they function more like keys that unlock the body's energy. When present in supplements individually, B vitamins are referred to by their name, for example, vitamin B1, or Thiamin. When all together they are known as "Vitamin B complex."

The B vitamins contribute in numerous ways to overall health and vitality. The compounds in a B-complex are needed for everything from the healthy maintenance of brain cells to the metabolism of carbohydrates, the brain's

source of fuel. B's are also necessary for the production of neurotransmitters, which regulate mood and conduct messages throughout the brain. A deficiency in any one of them can lead to a host of health problems.

Q & A WITH AOR

Q There are so many different B vitamins – what are their names and numbers?

VITAMIN	NAME	MAIN FUNCTION
B1	Thiamine	Converts protein, carbs, and fat from food into energy; nervous system function; proper muscle function; synthesis of DNA.
B2	Riboflavin	Converts protein, carbs, and fat from food into energy, skin health, and eye health. Also required for normal cell growth and function and for mobilization of other B-vitamins.
B3	Niacin	Converts protein, carbs, and fat from food into energy, fatty acid synthesis, improves cholesterol and helps regulate many metabolic processes.
B5	Pantothenic Acid	Converts carbs and fat from food into energy, production of red blood cells, healthy digestion, hormone production.
B6	Pyridoxine	Protein and amino acid metabolism, release stored glucose, hormone production, immune support, and also helps in the production of neurotransmitters essential for brain and mood health.
B7	Biotin	Converts protein into energy, carb metabolism, fat synthesis, hair and nail health.
B9	Folic Acid	Protein and amino acid metabolism, DNA synthesis, formation of red blood cells, essential for human growth and development (especially during pregnancy).
B12	Cobalamin	Food metabolism & energy production, DNA synthesis, formation of red blood cells, brain and nervous system function.

Q Which B vitamins are foundational?

Picking the most important B vitamins is like picking the most important parts of the body—they all work in synergy.

The eight individual members of the B family are commonly referred to as a B-complex. Although each B vitamin is unique, they have closely interrelated functions. The body does not store B- vitamins well, and its need for them is increased by stress, smoking, use of alcohol and drugs, unhealthy dietary practices, shift work, illnesses, and demanding travel schedules.

If you choose to supplement, there is no reason not to take the whole complex of eight B vitamins, but there are also instances where taking additional individual B vitamins may be appropriate. You do not want to take a single B-vitamin in the absence of a complex for too long, however, because their inter-relational ratios are essential for the maintenance of good health. When the need arises for a single B-vitamin, you could take the single as well as a B-complex for a temporary period until the issue is resolved and then revert to supplementing only the B-complex again.

As we can see, it is crucial to select a B-complex vitamin that has the most biologically active forms in scientifically balanced doses.





Q Is it possible to consume too many vitamins? What is the appropriate amount?

Taking too much of anything - even vitamins - can cause problems. Although some vitamins are relatively harmless in unlimited quantities because your body excretes the excess, others can only be taken in limited amounts before you risk harming your health.

B vitamins are water-soluble, which means the body excretes excessive amounts through urination. However, massive doses of B vitamins carry the potential to create some

temporary adverse reactions. For example, high levels of niacin (vitamin B3) may cause blurred vision, nausea and vomiting.

Recommended daily allowances (RDA) for B vitamins vary according to age, overall health and other factors, and are established by Canadian and American scientists through a review process overseen by the U.S. National Academies.

Talk to your health care provider if you have concerns about your B vitamin intake, as supplements containing some B vitamins may interact with certain medications.

Q Is it possible to eat well and still have a Vitamin B deficiency?

Despite a high intake of foods containing B-vitamins, it is still possible to have a deficiency in one or more of them as your body may not be absorbing the nutrient.

Anyone suffering from digestive problems, or pancreatic issues, someone who takes antacids and other medications such as oral contraceptives, cholesterol-lowering drugs, nonsteroidal anti-inflammatory drugs (NSAIDs), or anyone who has gone through weight loss surgery may not

have enough stomach acid to properly break down those foods and absorb the nutrients from them.

Age is another factor, more specifically in B12 absorption. As we age, the stomach does not produce as much hydrochloric acid (HCL) which can result in a decline of the amount of B12 that is absorbed.

Furthermore, extended cooking, food processing and alcohol can reduce the availability of many of these vitamins.

The definition of a healthy daily intake of B vitamins isn't set in stone, and it is likely to change over the next few years as data from ongoing randomized trials are evaluated.

Q Does it matter where I source my B Vitamin supplements?

A sure-fire way to assess the quality of your supplements is to check if the vitamins and mineral are in the most biologically active and absorbable forms. Most formulations contain vitamins and minerals in their most commonly used and often cheapest form. To the untrained eye, this may seem like an attractive option, especially if the formulation is low-cost. However, choosing a supplement with the most active forms of vitamin B can make the difference between a positive or negative effect on your health.

The body's physiology is complex; it may convert orally absorbed nutrients many times before they are in a useable form. A good example is vitamin B9,

which is found in different forms in folate and folic acid. Whereas folic acid is a synthetic compound used in common dietary supplements and food fortification, folate refers to the various tetrahydrofolate (L-5-MTHF) derivatives naturally found in leafy greens or biologically active supplements.

Any folic acid we ingest must be metabolized (converted) into Dihydrofolate (DHF), Tetrahydrofolate (THF), and then finally into L-methylfolate (5-MTHF) to be used by the body. However, issues can arise during the metabolism for people with a genetic polymorphism leading to an enzyme issue, such as an MTHFR mutation.

For those individuals, folic acid supplements are ineffective and potentially harmful in the long run.

Supplementing with 5-MTHF bypasses the entire folic acid metabolism cycle, which is good news if you have an MTHFR mutation. It's an example of how the sourcing of your B-vitamin supplements makes an essential difference to whether that product has a positive or potentially adverse effect on your health.

The majority of B vitamins on the market are synthetic. For these synthetic products, the dose is not necessarily a good indicator of a quality supplement. Naturally-sourced vitamins, on the other hand, are referred to as active B vitamins and are superior. The commonly used active B vitamins are listed below.

If you read the label and don't find these active names for the B vitamins, most likely they're synthetic. Some synthetic vitamins may convert to their active

forms once in the body, but they require additional nutrients. For example, in order for the body to utilize synthetic folic acid additional vitamin C, niacin and vitamin B12 are required.

Q What is methylation and why does it matter?

Methylation is the essential biochemical process through which folate and B12 help to form 'methyl' groups that attach to proteins, modifying their function. It controls hormones, neurotransmitters, growth and cellular replication, keeping the processes orderly. We will deal with Methylation in detail later in this issue.

Q Some practitioners give Vitamin B from an IV drip. When is that necessary?

Proponents say IV vitamin therapy delivers a high concentration of vitamins, minerals and amino acids directly to the body's cells, bypassing the digestive system to allow more rapid and effective absorption of nutrients than could be achieved by swallowing them. There are legitimate situations where you would give vitamins intravenously when people are either severely sick or cannot absorb vitamins properly.

THE MAJORITY OF B VITAMINS ON THE MARKET ARE SYNTHETIC. FOR THESE SYNTHETIC PRODUCTS, THE DOSE IS NOT NECESSARILY A GOOD INDICATOR OF A QUALITY SUPPLEMENT. NATURALLY-SOURCED VITAMINS, ON THE OTHER HAND, ARE REFERRED TO AS ACTIVE B VITAMINS AND ARE SUPERIOR.

VITAMIN	SYNTHETIC NAME	NATURAL (ACTIVE) NAMES
B1	Thiamine	Thiamine pyrophosphate; Thiamine triphosphate, Benfotiamine
B2	Riboflavin	Riboflavin-5-phosphate; Flavin mononucleotide (FMN)
B5	Pantothenic acid	Pantethine, calcium D-pantothenate
B6	Pyridoxine	Pyridoxal-5-phosphate
B9	Folic acid	Folinic acid; 5-methyl tetrahydrofolate, calcium L-5-MTHF
B12	Cobalamin	Methylcobalamin; Adenosylcobalamin
Choline	Choline	Phosphatidylcholine



VITAMIN B DEFICIENCIES – SIGNS AND CAUSES

Are You Vulnerable?
How To Avoid Deficiencies

BY DR. NAVNIRAT NIBBER, ND



A vitamin is characterized by the fact that, in its absence, key physiologic processes are blocked that can result in serious health consequences. This is made especially clear when we look at the role of B vitamins.

B vitamins act as co-enzymes in thousands of molecular processes in the body, and we have learned more about their unique functions by examining what happens when they aren't present than when they are. The concept of "characterizing by deficiency" has led to incredible discoveries, while highlighting the importance of prevention. So, while you may not notice when you have sufficient or slightly low levels of B vitamins, you definitely begin to notice as the deficiencies become more pronounced.

While it's ideal to know what your blood levels for the B vitamins are before supplementing- it is not always necessary for the treatment and prevention of certain deficiencies. This is due to the fact that most (though not all) B vitamins are well tolerated and have a low toxicity profile. An exception to this is niacin which can be toxic at very high doses. Further, as they are water soluble, excess concentrations are easily excreted in urine.

Unfortunately, this same notion has led to the development of some ineffective, unbalanced supplements. Understanding how specific deficiencies occur and what symptoms they cause helps us with more targeted and appropriate supplementation regimes, meaning you can supplement the right vitamin in the right form, at the right dose, at the right time. A truly orthomolecular approach.

WHO IS AT RISK

Before we get further into how to treat suspected deficiencies we must understand why they occur, who is at risk, and what signs and symptoms to look for. In general, a deficiency can be the result of 4 major factors:

- Blocked production or genetic abnormalities
- Inadequate or insufficient intake
- Poor absorption or lifestyle
- Competing or antagonistic molecules

COMMON VULNERABLE POPULATIONS

As such, some common vulnerable populations are individuals who are more susceptible to one or more of these factors. These include:

- The elderly
- Those with restrictive diets such as vegans or vegetarians
- Those suffering from chronic antibiotic use
- Smokers
- Individuals with malabsorptive concerns such as: Crohn's, Celiac, Ulcerative colitis, IBS

The following pages break down specific B vitamin deficiencies. We refer to both the standard and active forms of each as well as the signs and symptoms, causes, and vulnerable populations.

Also included is Health Canada's recommended dietary allowance (RDA). These RDA values are based on general adult population statistics.

It's important to remember that individual requirements will vary based on: current health status, nutrition, exposure to toxins, exposure to medical treatments, and many other factors. Further, these ranges do not address specific health benefits that may be related to higher doses.

NAME | B1 THIAMINE

ACTIVE FORMS | *salbutiamine, benfotiamine*

RECOMMENDED DIETARY ALLOWANCE | 1.2/1.1 mg (men/women)

SIGNS OF DEFICIENCY | The most serious deficiencies can lead to degenerative nerve disorders such as beriberi (wet and dry), Wernicke-Korsakoff syndrome (known as cerebral beriberi), as well as alcoholic neuritis.

- Dry beriberi presents with burning feet, loss of balance, and limb weakness.
- Wet beriberi also includes cardiovascular symptoms such as edema, tachycardia (racing heart) and heart failure in severe cases.
- Cerebral beriberi includes dementia, psychosis, amnesia and ataxia.
- Thiamin deficiency has been linked to Type II Diabetes

CAUSES OF DEFICIENCY | In underdeveloped countries, B1 deficiencies are usually found where foods made from white flour are staples. In the developed world, where such foods are often fortified with thiamin, the main reasons for deficiencies are alcohol consumption (which impairs thiamin absorption) and poor dietary choices.

Thiamine deficiency has also been linked to unstable blood sugar levels, particularly in the formation of advanced glycation end products (AGEs). AGEs are cellular proteins that are damaged as a result of being exposed to glucose without the mediating action of a coenzyme.

POPULATIONS AT RISK OF DEFICIENCY

- *Chronic or excessive alcohol consumption*
- *Diets high in processed flours*

NAME | B2 RIBOFLAVIN

RECOMMENDED DIETARY ALLOWANCE | 1.3/1.1 mg (men/women)

SIGNS OF DEFICIENCY | A riboflavinosis is the specific condition caused by riboflavin deficiency. Symptoms include sores around the mouth and swelling of the throat, cheilosis (cracks on the lips), and glossitis (inflammation of the tongue). Riboflavin deficiency may also cause seborrheic dermatitis, cataract formation and decreased neurotransmitter function.

CAUSES OF DEFICIENCY | A number of factors can lead to increased loss, or poor absorption of riboflavin including: poor diet, liver and endocrine disorders, and chronic diarrhea.

POPULATIONS AT RISK OF DEFICIENCY

- *Oral contraceptive pills decrease absorption of riboflavin.*

NAME | B3 NIACIN

ACTIVE FORMS | *Nicotinic acid, nicotinamide, Inositol, hexanicotinate*

RECOMMENDED DIETARY ALLOWANCE | 16/14 mg (men/women)

SIGNS OF DEFICIENCY | One of the most well characterized B-vitamin deficiencies is that of niacin. This is due to the fact that it can rapidly develop into a disease known as pellagra, characterized by dermatitis, insomnia, diarrhea, weakness, progressive cognitive decline and eventually death.

CAUSES OF DEFICIENCY | A deficiency in the essential amino acid tryptophan and vitamin B2 can cause a niacin deficiency. This is because vitamin B2 helps convert tryptophan into niacin.

POPULATIONS AT RISK OF DEFICIENCY

- *Traditionally, high corn diets were associated with niacin deficiency. However, any restrictive diets can result in the deficiency. Alcoholics, and individuals undergoing long term chemotherapy regimes and dialysis are at higher risk for deficiency.*

NAME | B5 PANTETHINE

Pantothenic acid

RECOMMENDED DIETARY ALLOWANCE | 5 mcg (men/women)

SIGNS OF DEFICIENCY | Symptoms of vitamin B5 deficiency are widespread due to the fact that it is required to produce a very important cellular energy molecule called coenzyme CoA. Symptoms of the deficiency can appear to be excessive stress or “burnout”, depression, fatigue, insomnia, and even parasthesias (burning and tingling in feet).

CAUSES OF DEFICIENCY | The formation of pantethine in the body is carefully regulated and reaches a maximum at a certain level. In some people, this level is not high enough for optimal health. Deficiency may also be due to high levels of biotin competing for absorption.

POPULATIONS AT RISK OF DEFICIENCY

- *Severe malnutrition, diets with highly processed, frozen and canned foods have less B5.*
- *Oral contraceptive pills increase B5 requirements.*

NAME | B6 PYROXIDINE

Pyridoxal-5'-phosphate (P-5-P; P5P)

RECOMMENDED DIETARY ALLOWANCE | < 50 years old: 1.3 mg (men and women), > 50 years old 1.7mg (men), 1.5mg (women)

SIGNS OF DEFICIENCY | P5P deficiency is associated with depression, irritability, confusion, and neuropathy. It can lead to anemia, dermatitis, hypertension, elevated levels of homocysteine and water retention, insomnia, premenstrual tension, muscle twitching, convulsions, and kidney stones.

CAUSES OF DEFICIENCY | While B6 deficiencies are rarer than others many drugs inhibit absorption including: anti-inflammatory, OCP, and drugs for treatment of Parkinsons disease.

POPULATIONS AT RISK OF DEFICIENCY

- *Alcoholics are at highest risk*
- *Tuberculosis patients*
- *Parkinson's patients*

NAME | B7 BIOTIN

RECOMMENDED DIETARY ALLOWANCE | 30 mcg (men/women)

SIGNS OF DEFICIENCY | The most characteristic feature of a biotin deficiency is a facial rash (around the eyes, mouth and genitals). Biotin deficiency also appears as alopecia, conjunctivitis, dermatitis, and neurological symptoms such as numbness/tingling, visual changes.

CAUSES OF DEFICIENCY | May be due to high levels of Pantetheine competing for absorption. Biotin is also rapidly depleted by common anti-seizure medications. Avidin (found in egg whites) binds biotin and causes deficiency.

POPULATIONS AT RISK OF DEFICIENCY

- *Individuals who have been on feeding tubes for prolonged periods of time are often not having biotin added to formulas.*
- *Diets with >10 egg whites per day.*
- *There are also a number of well-known metabolic disorders that block enzymes and transport of biotin.*
- *Pregnant women also have a higher requirement for biotin and may become deficient if not supplemented.*

NAME | B12 COBALAMIN

Cyanocobalamin, Methylcobalamin, Hydroxocobalamin, Adenosylcobalamin

RECOMMENDED DIETARY ALLOWANCE | 2.4 mcg (men/women)

SIGNS OF DEFICIENCY | A deficiency in vitamin B12 can cause:

- Megaloblastic anemia
- Cognitive changes and dementia
- Fatigue
- Peripheral neuropathies such as numbness tingling, tremors
- High levels of homocysteine (ie. increased cardiovascular risk)
- Depression and mood disturbances
- Changes in gait
- Poor balance
- Susceptibility to infection and facial pallor

CAUSES OF DEFICIENCY | Poor diet, impaired microbiota, pernicious anemia, malabsorption, use of antacid medications.

POPULATIONS AT RISK OF DEFICIENCY

- *Elderly*
- *Vegans (low methionine diets) and vegetarians*
- *Chronic antibiotic use*
- *Smokers*
- *Crohn's, Celiac, Ulcerative colitis or other malabsorption conditions*
- *Genetic Factors*

NAME | FOLATE

Folic Acid

RECOMMENDED DIETARY ALLOWANCE | 400 mcg (men/women)

SIGNS OF DEFICIENCY | Folate deficiency can cause a number of health problems with the most documented being neural tube defects in a developing fetus during pregnancy. Symptoms of folate deficiency include: weakness, fatigue, irritability, headaches, difficulties in cognitive function, mood imbalances, cramps, palpitations, shortness of breath, and can lead to more serious health problems.

CAUSES OF DEFICIENCY | Certain medical conditions can actually lead to secondary folate deficiencies through decreased absorption or an increase in the body's demand for folate. These include alcoholism, Crohn's disease, lymphoma or amyloidosis of the small intestine, diabetic enteropathy, gluten sensitivity, sickle cell disease, chronic exfoliative skin disorders, and of course, pregnancy.

Additionally, a large percentage of the population has a certain gene mutation called MTHFR which renders them unable to convert dietary folate into the biologically active form, leading to folate deficiency.

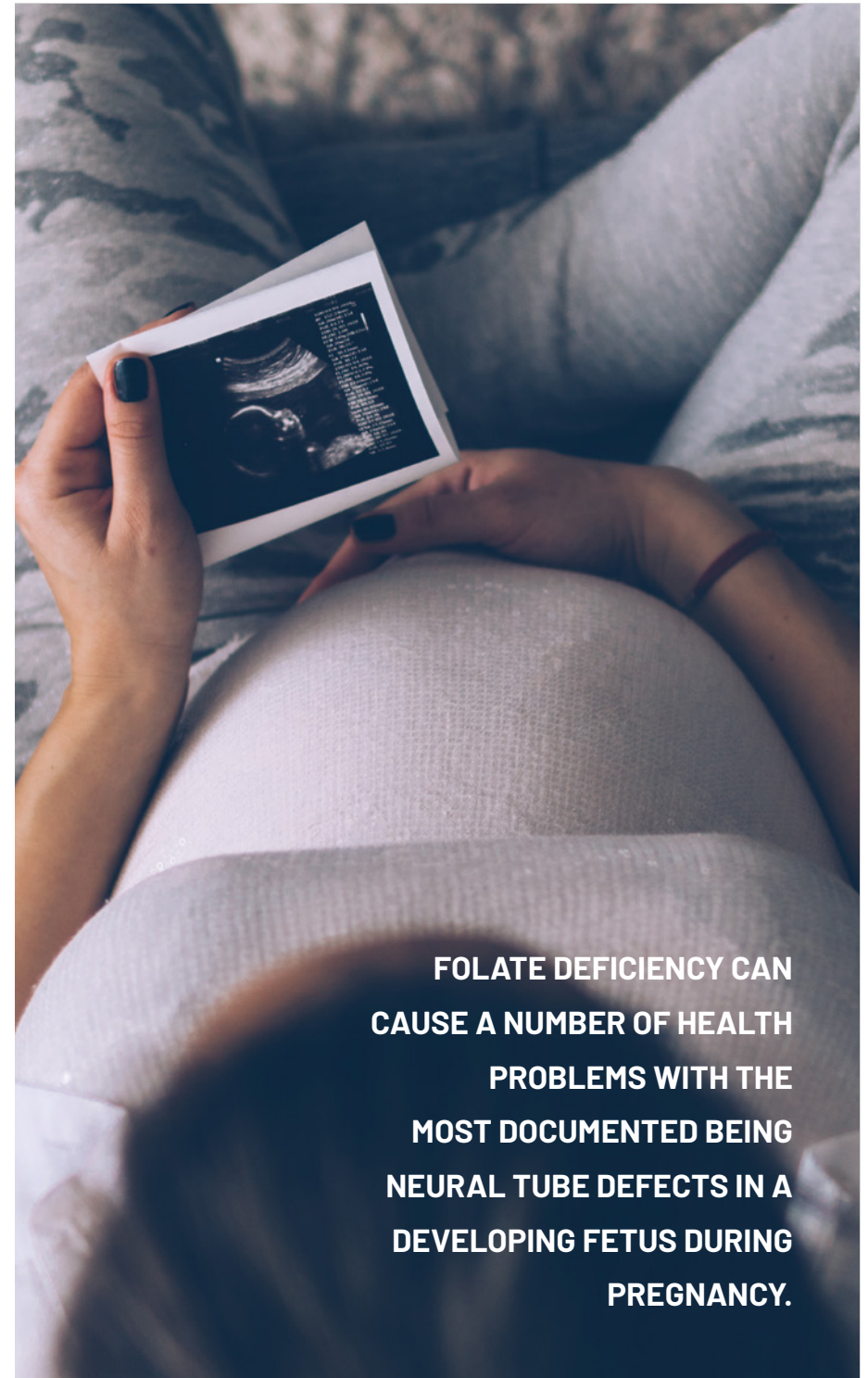
POPULATIONS AT RISK OF DEFICIENCY

- **Smokers are particularly susceptible to deficiency.**
- **Pregnant women also have a significantly greater need for sufficient amounts.**

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FOLATE DEFICIENCY CAN CAUSE A NUMBER OF HEALTH PROBLEMS WITH THE MOST DOCUMENTED BEING NEURAL TUBE DEFECTS IN A DEVELOPING FETUS DURING PREGNANCY.

THE VITAL ROLE VITAMIN B PLAYS IN OUR LIFE STORY

BY DR. AARON ZADEK, ND

The role that Vitamin B plays, from the time we are in the womb right through the ageing process, cannot be underestimated. Let's explore the importance of this family of vitamins throughout our life cycle.



THE IMPORTANCE OF VITAMIN B DURING PREGNANCY

Nutritional deficiencies can lead to adverse outcomes in reproduction such as infertility and miscarriage. In pregnancy, a B12 deficiency can lead to complications in neonatal development, increasing the risk of preterm birth and lower birth weight.¹ Low levels of maternal red blood cell folate and high homocysteine values mid-pregnancy have also been found to be associated with reduced fetal growth.²

VITAMIN B6 FOR NAUSEA

Nausea and vomiting are common during early pregnancy. Studies have shown Pyridoxine (vitamin B6) reduces the severity of nausea and vomiting in pregnant women.³ Study participants between 6 and 16 weeks' gestation given 40 mg of pyridoxine twice daily had significant improvements in symptoms versus those given placebo. Interestingly, the anti-nausea effects of B6 were comparable to that of ginger.

B VITAMINS AND MOOD AND HORMONE REGULATION

B Vitamins perform a variety of actions that relate directly to the production of neurotransmitters, hormones, and therefore, mood. Through their blood sugar regulating actions, they help reduce mood swings, improve sleep, and assist the liver in detoxifying estrogens.⁴ Pyridoxine, in particular, is needed for the body to produce GABA, dopamine and, with niacin and inositol, serotonin.⁵ They regulate how we feel and how we process and respond to stress. There is a well-documented link between a deficiency of B vitamins and depression, anxiety and stress.

VITAMIN B AS ENERGY BOOSTER

B vitamins are well-known for their energy-boosting abilities. Thiamin (B1), riboflavin (B2), niacin (B3), pantothenic acid (B5), pyridoxine (B6) and biotin (B7) all play important supportive roles in the energy-producing reactions performed when our body breaks down

carbohydrates, fats and proteins.⁵

B vitamins serve as co-factors in breaking down our food and are critical to ensuring the body is producing energy efficiently for immediate use or storage. Without them we are often left feeling worn out, stressed and, in some cases of severe deficiency, we may experience neurological symptoms such as muscle weakness and numbness. Other B vitamins, such as folic acid (B9), cobalamin (B12,) along with B5 and B6, contribute to our red blood cell production.⁵ When we have healthy red blood cells, we are delivering oxygen efficiently, keeping our brain, muscles and nervous system happy.

B VITAMINS AND HEART HEALTH

Several B vitamins have been identified as important to our cardiovascular health. Elevated homocysteine levels also pose an increased risk of damage to our blood vessels, resulting in arterial hardening known as arteriosclerosis. Arteriosclerosis develops when cholesterol is deposited into the arterial wall, leading to the formation of plaques. It is thought to occur when an abnormal distribution of cholesterol is present, due to poor dietary habits or genetic predisposition.⁶ While many B vitamins help reduce these risks, niacin has been touted as one of the most effective interventions for the reduction of cholesterol. Its therapeutic effects are outlined in Table 1.

BIOMARKER	WHY THIS MARKER MATTERS	EFFECT OF NIACIN
Total Cholesterol	Most simple measurement of total amount of cholesterol.	Up to 13% reduction
LDL-C (Low density lipoprotein cholesterol)	Known popularly as "bad cholesterol," it has been considered for decades as one of the most important heart risk measurements.	Up to 25% reduction
Lipoprotein (a)	A small type of LDL, this particle is known to target the wall of the artery with high attraction, resulting in the formation of fatty plaques.	Up to 30 % reduction
Triglycerides	Increased in cases of diabetes (type 2) and metabolic syndrome, correlated to insulin resistance.	Reduction 20-50%
HDL-C	Known popularly as "good cholesterol," Low levels typically related to increased cardiovascular risk.	Improvement of 15-35%

TABLE 1.

Effects of Niacin supplementation on heart health ^{6,7,8,9}

B VITAMINS & COGNITIVE DECLINE

Lately, there are many questions as to whether or not B vitamins are useful in helping those experiencing cognitive decline or neurodegeneration. Several forms of B vitamins have shown to be protective for the brain and beneficial in repairing damaged nerves.^{10,11} Methylcobalamin, the methylated form of B12, has been shown to be helpful after nerve injury by assisting in rebuilding myelin, which improves speed and delivery of signalling through the nerves.¹¹ Another B vitamin that has been shown to be neuroprotective is Benfotiamine, a more fat-soluble form of thiamin that is shown to be absorbed up to 5 times more and is up to 3.6 times more bioavailable than thiamin hydrochloride.¹² Studies have suggested that Benfotiamine helps decrease symptoms of diabetic retina and nervous system damage caused by excess blood sugar which, if left unmanaged, can result in vision impairment and loss of sensation.¹⁰

The brain consumes considerable energy to function. When available energy drops, cognition is affected. Thiamine is essential to brain function, helping regulate the release and availability of energy to the brain. Disruption of this process is considered one of the most important precursors to cognitive impairment and progression of Alzheimer's Disease (AD). This has led to the suggestion that TDP, a thiamine metabolite, be used as a biomarker for Alzheimer's diagnosis, as those with AD have lower circulating levels of TDP.¹³

Benfotiamine has been studied in 5 subjects with mild-moderate Alzheimer's disease for 18 months to see if correcting low levels improved cognition.¹⁴ Each participant who took 300 mg/day oral Benfotiamine over 18 months and showed cognitive improvements via mini-mental status examination.

FOLATE, VITAMIN B12 AND ALZHEIMER'S DISEASE.

One approach to studying cognitive decline has been to investigate non-genetic risk factors associated with the development of Alzheimer's disease (AD). One such risk factor is high blood levels of the amino acid homocysteine.¹⁵ When homocysteine is significantly elevated in our body, it results in physiological stress that can increase inflammation, as well as damage our cardiac and nervous systems. Folate and B12 are known to help remove homocysteine from the blood and, interestingly, these vitamins have been found to be low in individuals diagnosed with AD. In one study, a high-dose B vitamin treatment including folic acid, B6 and B12 slowed shrinkage of whole brain volume over two years compared to placebo.¹⁶ It is important to note that not all cases of AD feature elevated homocysteine levels.

Studies that have looked at the combination of folate, B6 and B12 have not been shown to slow cognitive decline in those with normal homocysteine levels.¹⁵



STRONGER WHEN COMBINED WITH OMEGA-3 FATTY ACIDS?

One retrospective study looked at the use of omega-3 fatty acids with B6, B12, and folate in elderly individuals over the age of 70 with mild cognitive impairment.¹⁷ Interestingly, B vitamin supplementation was only found to be beneficial in those with high baseline omega-3 levels, slowing brain atrophy by 40% compared with the placebo group. The researchers also acknowledged that AD patients with high homocysteine levels were less likely to respond to B vitamin intervention if the individual's omega-3 fatty acid levels were low. It appears as though an individual's use of omega-3 fatty acids before AD development may augment the effect of B vitamins in slowing cognitive decline and brain atrophy. Additional research with larger treatment groups is warranted to understand the lifestyle factors that may contribute to the progression of cognitive decline. While B vitamins may help slow decline, it is important to point out that the goal should be to reduce homocysteine levels earlier in life to control inflammation and reduce the risk factors that are within our control.

As we can see, the B family of vitamins are critical to the overall health of our hearts and minds – as well as the rest of our bodies – from before we are born and throughout our lives.

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DE-MYSTIFYING METHYLATION

BY DR. ROBYN MURPHY, BSC, ND

Even without a science degree, you likely have come across the term methylation. It's receiving attention in the medical community these days because of its widespread impact on health. But what exactly is methylation? In humans, this reaction occurs in every single one of our cells, except red blood cells, which gives some insight into how vital methylation is, not only for survival but for us to thrive.

Methylation is an essential biochemical process that forms the basic building blocks for hundreds of different biochemical reactions in the body. Through this pathway, folate and vitamin B12 help to form 'methyl' groups (CH₃) that attach to proteins, modifying their function.

Why is this important? It is a way for the body to form and degrade active proteins, making sure that certain biological processes are under tight control. This avoids excess hormones, neurotransmitters, growth and cellular replication. In other words, methylation avoids complete chaos.

Methylation is important for: ^{1,2,3}

1. **Regulating mood** – modifying the conversion of neurotransmitters adrenalin, dopamine, serotonin, melatonin and histamine
2. **Creating and repairing DNA** – forming the base pair thymidine
3. **Regulating gene expression** – through epigenetic modification
4. **Enhancing immune function** – necessary for production of red and white blood cells, and platelets
5. **Supplying energy to the body** – forming Coenzyme Q10, carnitine and creatine
6. **Muscle repair and protein production** – for heart, skeletal and smooth muscles
7. **Cell membrane and nerve protection** – manufacturing of phospholipids and myelin
8. **Producing and balancing hormones** – including thyroid, cortisol and estrogens
9. **Assisting in detoxification** – affecting methylation, glutathione and sulfur pathways

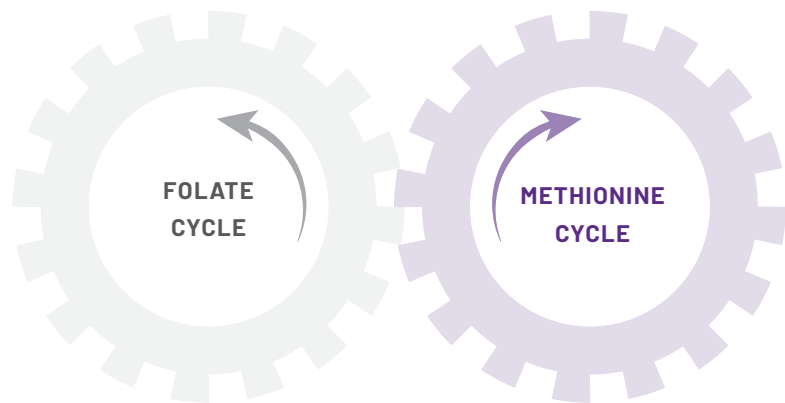


FIGURE 1.

The folate cycle and methionine cycle work together like two gears.

To understand the methylation pathway and how it affects overall health and how you can impact it, let's break it down. Methylation is made up of two pathways, the folate cycle and methionine cycle (Figure 1). Together these pathways work like two gears of a clock. As one moves it propels the other.

THE FOLATE CYCLE

Folate comes from the Latin word meaning foliage, found abundantly in dark leafy greens. Folate also comes in a synthetic form known as folic acid. In order to be usable by the body, folate must be converted into its active form, known as **5-MTHF**

(5-methylenetetrahydrofolate).

The body accomplishes this using the enzyme **MTHFR** (among others).

METHIONINE CYCLE

Now let's look at the other important methylation pathway, which involves homocysteine. Homocysteine is an amino acid and breakdown product of our metabolism that is toxic in high concentrations. It is an independent risk factor for cardiovascular disease, including stroke and hypertension, and strongly associated with Alzheimer's disease and dementia. One way the body reduces levels of homocysteine is through the methionine cycle.

It uses the active form of folate (remember, 5-MTHF) and vitamin B12 (methylcobalamine) to convert homocysteine into methionine.^{2,4,5} Here's a summary of what happens next.

- Methionine then goes on to produce SAMe (S-adenosylmethionine). SAMe is what the body uses for the processes mentioned above.
- The enzyme **methionine synthase** (MTR) requires both the active forms of folate and vitamin B12 to transform homocysteine into methionine.
- The enzyme **methionine synthase reductase** (MTRR) recycles Vitamin B12 to ensure the active form is available.⁶

The figure below shows how these two cycles orchestrate the production of SAMe, using a combination of enzymes, vitamins and minerals. In addition to **folate** and **vitamin B12**, **vitamins B2, B3, B6, magnesium**, and **zinc** are necessary to lower homocysteine and ensure proper methylation.

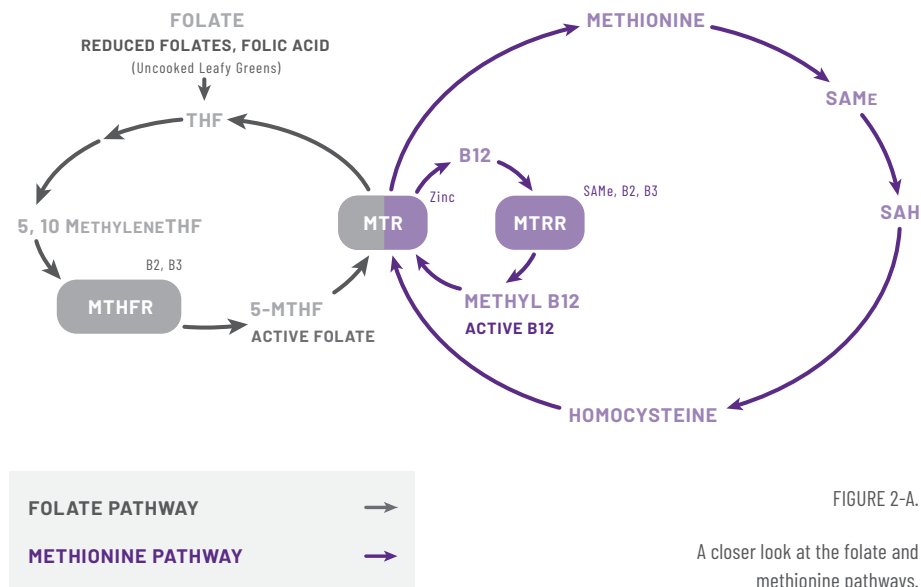


FIGURE 2-A.

A closer look at the folate and methionine pathways.

SIGNS OF POOR METHYLATION

If the body is low in the vitamins and minerals necessary for methylation or is under physiological stress (as in toxic exposure, inflammation, or infection), widespread symptoms may emerge. These may include depressive symptoms, poor cellular repair (poor wound healing, digestive complaints), chemical sensitivities, low energy, poor immunity and hormone imbalance. These symptoms may indicate 'poor methylation' status.³

SIGNS OF EXCESS METHYLATION

Those suffering from the problems that arise from 'poor methylation' described above, may choose to supplement with methyl donors, such as methyl-B12, methyl-folate (5-MTHF) and SAME. However, caution is recommended with amounts. Some may be sensitive to these forms and require additional support to prevent what could be known as 'excess methylation'. Signs include; anxiety, poor concentration, panic disorder, insomnia, excess inflammation, aggravation of food/chemical sensitivities, and histamine intolerance.⁷

INABILITY TO METHYLATE

There are a number of reasons that may influence the body's ability to methylate.

- Poor dietary intake of folate, vitamin B12 and protein. Those who are vegetarian, vegan or have chronic digestive complaints (IBD) are more likely to have deficiencies in protein and vitamin B12.⁸

- Toxin accumulation, low antioxidant status and inflammation. The MTR enzyme is susceptible to heavy metals, oxidative stress, mineral deficiency and chronic infections. This signals the body to reduce SAME production, diverting the pathway to produce glutathione.
- Genetic variations. Discoveries in human genetics reveal how changes in the genetic code can lead to reductions in the efficiency of the methylation cycle. This leads to an increase in homocysteine and risk for disease, which we will describe in our genetic testing section.

BEYOND MTHFR

The body is smart and usually has a number of different ways to accomplish an end goal. This avoids the possibility of severe biochemical road blocks that may be detrimental to survival. Methylation is no exception. The body has several additional pathways to reduce homocysteine levels.

ALTERNATE METHYLATION PATHWAYS

The alternate pathways to reduce homocysteine include the Betaine pathway and the Transsulfuration pathway.

BETAINE PATHWAY

Betaine, also known as trimethylglycine (TMG) is an alternate route for the body to reduce homocysteine levels. The enzyme betaine-homocysteine methyltransferase (BHMT) requires

zinc and betaine to function. Choline is also important to the process.²

TRANSULFURATION PATHWAY

If the body needs to produce more antioxidants or increase detoxification it can degrade homocysteine into glutathione. This is through the transsulfuration pathway, whereby homocysteine is broken down into cysteine using the CBS enzyme.⁹ The enzyme cystathione-beta-synthase (CBS) requires vitamin B6.

Methylation connects hundreds of biochemical processes, and as such, may have a huge impact on overall health. It is essential to identify possible errors in this process and the key vitamins and minerals necessary to

correct these alterations, ultimately reducing risk of disease.

METHYLATION CONNECTS HUNDREDS OF BIOCHEMICAL PROCESSES AND AS SUCH, MAY HAVE A HUGE IMPACT ON OVERALL HEALTH.

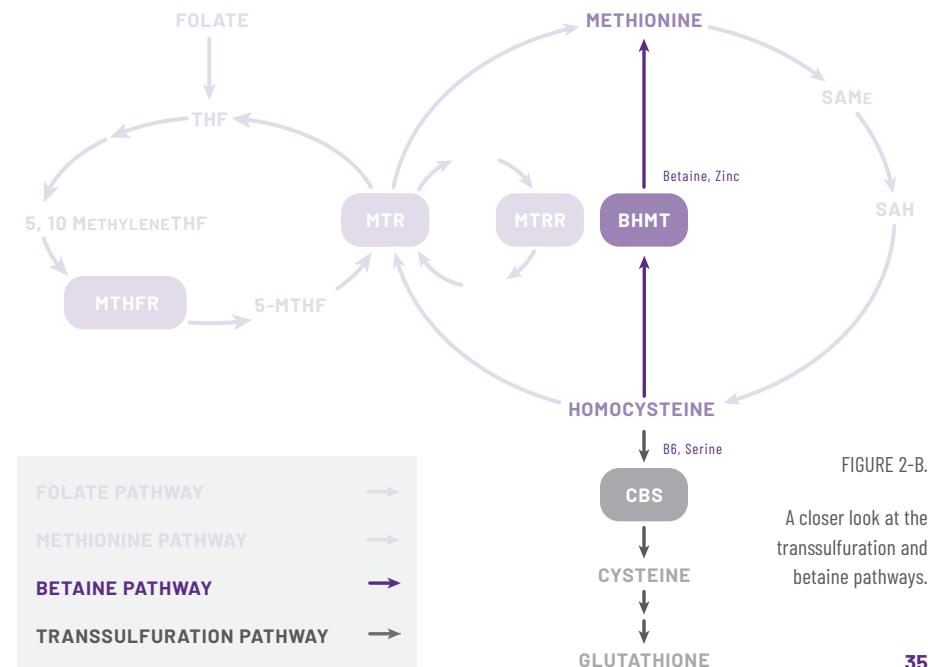


FIGURE 2-B.

A closer look at the transsulfuration and betaine pathways.



IS METHYLATION AN ISSUE FOR YOU? FIND OUT WITH TESTING

To assess overall methylation status, there are some simple tests that are helpful, including blood, urine and genetic analyses.^{9, 10}

Standard labs can test for the following: Homocysteine, complete blood count (CBC), red blood cells (RBC), folate, RBC Magnesium, Vitamin B12, Methylmalonic acid (for adenosyl B12 deficiency), Zinc, Organic acids urine testing for B Vitamin status.

GENETIC TESTING

One way to determine your susceptibility to poor methylation is through genetic testing. Genetic variations are responsible, not only for how different we look from one another, but also for our biochemical individuality. For example, studies reveal that two people eating the same amount of folate show different levels of folate in the blood. Why? Some people are less efficient at using dietary folate and are subsequently at a greater risk of folate deficiency. The reason for these differences are due to changes in the gene known as MTHFR.

There are approximately 23,000 genes within the human genome, made up of DNA, and represented by a set of 'letters' (A, C, T and G) that define the genetic code. Similar to a blueprint, which are instructions for an architect on what to build, the genetic blueprint contains instructions to the cell on what biological building blocks to construct.

Genetic testing examines an individual's genetic blueprint and more specifically the changes within this blueprint that lead to one's biochemical individuality. One way genetic variation may occur is through mutations in the genetic code, and the most common form of mutation in humans is a SNP.

WHAT ARE SNPS?

Single nucleotide polymorphisms, or SNPs, are "mutations" or changes in the genetic code. Changes to the genetic code can alter the gene product and therefore affect the cell's biological building blocks. One example is the SNP C677T in the MTHFR gene. This SNP changes the genetic code from a C to a T, reducing the MTHFR enzyme efficiency by up to 70%. This subsequently leads to a reduction in 5-MTHF (active folate) availability and an increase in homocysteine. Ultimately this leads to an increase in certain diseases.¹¹

GENETIC VARIATIONS ARE RESPONSIBLE, NOT ONLY FOR HOW DIFFERENT WE LOOK FROM ONE ANOTHER, BUT ALSO FOR OUR BIOCHEMICAL INDIVIDUALITY.



HOW GENETIC MUTATION TESTING CAN HELP

SNP testing allows individuals and their doctors to gain a better understanding of what's happening on a genetic and cellular-level, including methylation. It can identify one's susceptibility to potential problems with methylation, risk for disease and direct specific testing and treatment to compensate for inborn genetic errors.

With regards to methylation, genetic testing can help to determine a number of solutions:

- **Identify an ideal form of vitamin B12:** Those with certain variations of the COMT gene may experience anxiety with the 'methyl' forms of B12. A blend of hydroxy and adenosyl B12 are preferable forms to avoid this reaction.
- **Ways of taking vitamin B12:** Those with a certain version of the FUT2 gene are susceptible to vitamin B12 deficiency and may benefit from sublingual forms of B12.^{12, 13}
- **Daily dosage of folate:** Those with the slow version of the MTHFR gene are susceptible to folate deficiency and require a minimum intake of 400mcg of folate per day.¹⁴
- **Specific treatments:** Those with multiple at-risk variants within the methylation are at risk for high homocysteine. If homocysteine levels are high, these individuals can benefit from taking specific minerals (zinc, magnesium, copper)

and vitamins (vitamins B2, B3, B6, 5-MTHF and B12).¹⁵

- **Disease prevention:** Identifying an increase risk in disease can provide a huge opportunity to make the necessary lifestyle and dietary changes to significantly reduce the risk of getting that disease. With such a plethora of good advice, genetic testing helps decide what advice will have the biggest effect on your health.

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B VITAMINS:

Myths and Controversies

BY DR. SARAH ZADEK, ND

Social media posts often warn us of the dangers of certain foods, products and supplements. Although some of these have merit, many are based on misinterpreted research or poorly designed studies. This has often been the case with B-Vitamins. Although they have a reputation for being “energy boosters,” and have many vital functions in the body, studies and headlines have been published that link supplemental B vitamins (vitamins B2, B6, B12, and folic acid) with autism and cancer. Let’s take a closer look to find out what the research is actually showing.



DOES FOLIC ACID INTAKE INCREASE THE RISK OF AUTISM?

THE ROLE OF FOLIC ACID

Before we address the autism myth, it’s essential to understand folic acid’s role in the body.

In pregnancy, there is a greater need for folate because the fetus requires it. Folate (aka vitamin B9), along with vitamins B6 and B12, are part of the methylation cycle. As discussed in this Truth Series in the article by Dr Robyn Murphy, one goal of this cycle is to reduce and recycle a compound called homocysteine which can cause inflammation, damage and malformations in the developing fetus. Folic acid, B6 and B12 help to prevent this.

Most notably, folic acid is critical during pre-conception and early pregnancy to prevent neural tube defects: issues with the development of the brain and spinal cord. For this reason, public health initiatives fortified grain-based foods with folic acid, and since then we have successfully reduced the incidence of these defects. However, there are concerns regarding harmful developmental effects of too much folic acid, especially when you combine dietary folate with supplemental folic acid.

THE FORMS OF FOLIC ACID

First, it’s important to understand the differences between dietary and supplemental forms of these vitamins and note that they are not all equal. For example, folate can be supplemented in a synthetic “folic acid” form, or the more active, bioavailable form, 5-methyltetrahydrofolate (5-MTHF). Both can be called folic acid, but they are not the same molecule, and therefore the body treats them differently.

Most commercially available supplements use the synthetic form of folic acid which must be transformed twice (into dihydrofolate and tetrahydrofolate) by particular enzymes. These forms aren’t used in the same way as natural folate and

therefore often remain unmetabolized in a less useful state in the blood.

Some researchers have voiced concerns that too much of this unmetabolized folic acid can lead to issues in infants and children, such as increased fat mass and insulin resistance¹, increased seizure activity, and behavioural dysregulation.² It is believed that folate transformation pathways become saturated when more than 400mcg per day is ingested, after which folic acid is transported into the blood without being converted to the active form.³

HIGH FOLIC ACID CAN MASK A B12 DEFICIENCY

When addressing concerns about folic acid intake, the second problem researchers make is not accounting for several other relevant factors, including B12 levels. It is well understood that high folic acid levels can mask a B12 deficiency. This has been the case in some of these studies, where folic acid levels may have been high, but B12 levels were low or deficient. Therefore, the health issues we see in these studies could be due to too much circulating unmetabolized folic acid or, deficient B12 levels. Mothers with a B12 deficiency would have affected the study results.

Ideally, future research will compare the effects of using the biologically active 5-MTHF form, which has already displayed proven additional benefits: reducing the potential for masking a B12 deficiency while eliminating the issue of mutations in folic acid enzymes. 5-MTHF also prevents

the issue of having unmetabolized folic acid in the bloodstream.

The risk of autism seems to correlate more closely to the types of genetic mutations that affect the enzymes that transform and activate vitamins and nutrients. As well, we need to be mindful of how these B vitamins interact and work together. A high intake of folic acid itself may not be harmful, but excessive doses of synthetic forms with correspondingly low levels of vitamin B12 could increase health risks.

ROLES OF FOLIC ACID ON NEURODEVELOPMENT DURING PREGNANCY

Researchers have looked explicitly at the association between folic acid supplementation in pregnancy and outcomes of autism spectrum disorders (ASD), developmental delay, cognition, attention, and other emotional and behavioural concerns in children. In one systematic review of 22 original papers, 15 showed that folic acid reduced the risk of infants and children developing ASD, and 6 studies found no difference.²

A study of over 85,000 children revealed that the rate of ASD in children whose mothers took folic acid was 0.1% compared to 0.2% in mothers who did not supplement. Other studies showed that the risk of developing ASD was lower in mothers who took 0.6-5mg of folic acid daily – one even showing that these children had increased scores for receptive and expressive communication by 18 months.

However, one study did note a higher risk of ASD when mothers consumed amounts larger than 5mg daily.²

The authors of this review concluded that folic acid supplementation in pregnancy may protect against impaired neurodevelopment, including ASD in children, and may improve cognitive, intellectual, and motor function.

THE BOTTOM LINE ON FOLIC ACID AND AUTISM?

A folate deficiency before and in the first 12 weeks of pregnancy is associated with an increased risk of issues in neurodevelopment. Supplementation can reduce this risk by up to 70%.² The tolerable safe upper limit of folic acid supplementation is 1mg per day, and there seem to be no health risks associated with naturally-occurring folate in foods. The increased risk of ASD and health outcomes occur when synthetic folate is consumed in more substantial amounts (potentially >400mcg) by individuals with: a vitamin B12 deficiency, a genetic mutation in folate enzymes, or when daily doses exceed 5mg.

WHEN ADDRESSING CONCERNS ABOUT FOLIC ACID INTAKE, THE SECOND PROBLEM RESEARCHERS MAKE IS NOT ACCOUNTING FOR SEVERAL OTHER RELEVANT FACTORS, INCLUDING B12 LEVELS.



CANCER RISK AND B-VITAMINS

LUNG CANCER AND B-VITAMIN SUPPLEMENTATION

In addition to their role in the methylation cycle, B-Vitamins help produce the components of DNA. When B-Vitamins aren't available, a substitute part goes into the DNA strand, causing breaks, disrupting repair, and can lead to cancer-like changes. These changes have been shown to occur when there are low levels of folic acid and B12, as well, with high levels of homocysteine.⁴ Because of this role, B vitamins have been considered protective against cancer, though confusingly, many studies have reported adverse effects of B vitamins on cancer risk.

As an example of a study that found a link between B supplementation and lung cancer risk, over 77,000 men and women between the ages of 50-76 years were asked to report their intake of all vitamin supplements used during the past 10-years (before baseline), including doses and brands.⁵ The study followed up on cancer outcomes of these subjects over an average of 6 years. The first issue is in relying on people to remember which supplements they took 10 years ago. Many patients can't recall which brands of supplements they're currently using, so having to rely on memory is a faulty way of collecting data.



Secondly, this study excluded people who had never smoked cigarettes because the incidence of lung cancer in that group was so low. So ultimately, this study only looked at the risk of lung cancer in cigarette smokers who were supplementing with B vitamins. More so, those with lung cancer were more likely to be current smokers, have more pack-years of smoking and have a history with chronic obstructive pulmonary disease (COPD) or cancer.⁵

The conclusion? Male smokers who took higher doses of vitamins B6 and B12 over 10 years had a 30-40% increased risk of developing lung cancer. This risk was not found in women.⁵ Let's posit some reasons for this outcome.

As mentioned above, taking certain supplemental B-Vitamins can be beneficial in reducing the risk of cancers. Both methylcobalamin B12 and the 5-MTHF form of folate are methyl donors, and as such, actually, help protect against DNA damage (which can lead to gene mutations and cancer). However, in the presence of already mutated or abnormal cells (more common in male smokers) additional B vitamins could potentially lead to more rapid cell growth and therefore could theoretically promote the development and growth of cancer cells.

A controlled trial in Norway investigated cancer outcomes in men and women (mean age 62 years) taking B vitamins for over 3 years, following up with them years later.⁶ Although the authors concluded that folic acid and B12

supplementation increased the risk of cancer, their methods were flawed. Patients with a history of cancer were included, and all participants had ischemic heart disease. As well, 39% of participants were smokers (a higher percentage of smokers than in all of the United States).⁶ This abnormally high percentage of smokers creates a considerable problem as current smokers or those with a history of smoking are significantly more at risk of nutritional deficiencies. Smoking tobacco can destroy or disable nutrients such as vitamin B6, B12 and folic acid. The toxic components in cigarette smoke convert B12 back to its inactive form, leaving smokers with significantly higher amounts of inactive B12 compared to non-smokers.⁷ Therefore, B12 and its actions are relatively disrupted in those who smoke cigarettes, and these results cannot be applied to the general population.

POSITIVE STUDIES ON B VITAMINS AND THE PREVENTION OF CANCER

In northern China, a study of a population known to have low vitamin B2 (riboflavin) levels found that the incidence of oesophageal cancer was reduced when salt was fortified with riboflavin (4). Additionally, higher blood levels of riboflavin were significantly associated with a reduced risk of this type of cancer. However, the authors noted that this effect might be limited in adults who start supplementation later in life, and especially after a lifetime of nutritional deficiency.

Another review study found that dietary folic acid reduced the risk of oesophageal cancer by 12% for every 100mcg increase in folic acid dosing.⁸ Another study found that each 1mg per day increase of vitamin B6 decreased the risk of oesophageal cancer by 16%.⁹ Lastly, a European study found that higher dietary folate intakes were associated with lower risks of sex hormone-related breast cancers.¹⁰

THE BOTTOM LINE ON B VITAMINS AND CANCER RISK


From the studies listed in this article, it would be irresponsible to say that B vitamins increase the risk of cancer. Caution should be exercised in those with a history of cancer, a history of smoking, and those with a significant risk of DNA damage from life-long nutritional deficiencies. There is evidence to show that B-Vitamin supplementation is generally beneficial for reducing cancer risk, with potentially better results when consuming the active methylated forms of B12 and folic acid: methylcobalamin and 5-MTHF, respectively.⁵

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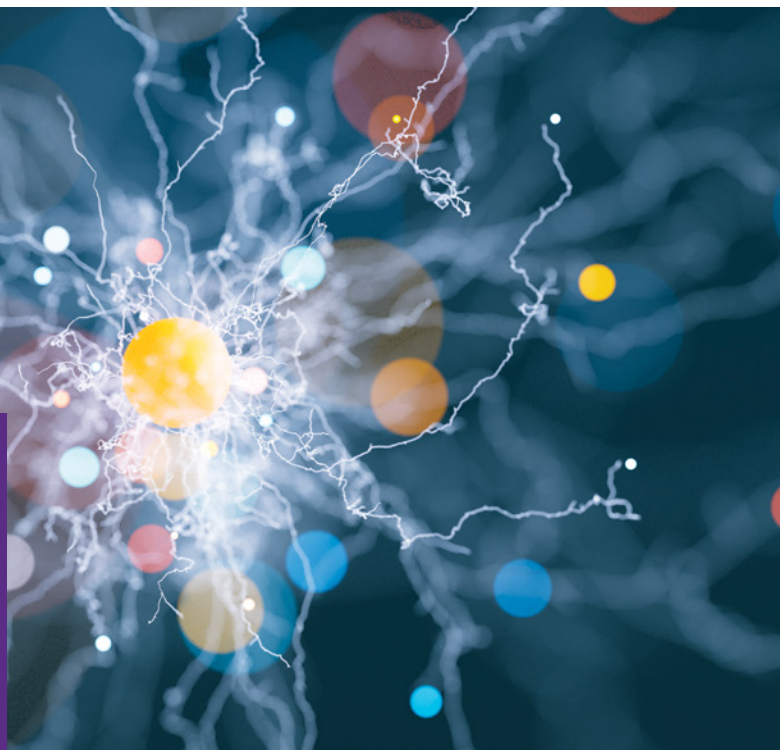


CAUTION SHOULD BE EXERCISED IN THOSE WITH A HISTORY OF CANCER, A HISTORY OF SMOKING, AND THOSE WITH A SIGNIFICANT RISK OF DNA DAMAGE FROM LIFE-LONG NUTRITIONAL DEFICIENCIES.

NUTRIENT SPOTLIGHT

Pyrroloquinoline Quinone (PQQ)

BY DR. PAUL HRKAL, ND



WHAT IS PQQ?

In 2003, scientists discovered a compound called Pyrroloquinoline quinone (PQQ) that was classified as part of the B-Vitamin family. PQQ is considered an essential vitamin because our bodies do not produce it and therefore it must be obtained from food or supplements. It also falls under the B-Vitamin category because it plays a role in the metabolism of the essential amino acid lysine, which helps form collagen (essential to all connective tissues) and aids in the production of immune system components, hormones and enzymes.

WHAT DOES IT DO?

PQQ supports the mitochondria.

Each cell contains energy-producing structures called the mitochondria. While their primary role is to produce energy (in the form of ATP), the latest evidence is clearly showing that they also are intimately connected to inflammation, microbial infections, oxidative damage and to regulating cell lifespan. It is not surprising that any state of mitochondrial dysfunction is associated with many diseases and conditions, including chronic pain, ageing, obesity, diabetes, cardiovascular and neurological diseases and many others.

One of PQQs main functions is to work as an antioxidant within mitochondria, protecting them from oxidative damage¹. Preliminary evidence suggests that it may be thousands of times more powerful than vitamin C as an antioxidant as it can quench free radicals over 20,000 times while vitamin C can only do it 4 times before being used up.² It also directly stimulates key enzymes in the mitochondria to boost energy production. The most exciting function of PQQ is that it is the only nutrient that can cause the spontaneous generation of new mitochondria within ageing cells – a process known as mitochondrial biogenesis.² No other nutrient can do this! Some experts feel that this effect could be the “fountain of youth” for mitochondrial function.



TO SUMMARIZE:

- **PQQ is a recently discovered compound that is part of the B-vitamin family.**
- **PQQ increases cellular energy production and nerve growth factors.**
- **PQQ has the unique ability to increase the number of mitochondria. No other natural substances have this ability.**
- **PQQ has been proven in research to improve memory and brain health in combination with CoQ10.**
- **PQQ is found in foods in small doses but must be supplemented to get therapeutic benefits.**

PQQ AND THE BRAIN

Some animal trials have shown interesting effects on nerve regeneration and growth.¹ A 2003 study conducted in Japan tracked elderly patients and found that there was an improvement in memory after 12 weeks when PQQ and Coenzyme Q10 were supplemented together. Scientists believe PQQ's neuroprotective benefits are due to its antioxidant activity and ability to stimulate a powerful compound called Nerve Growth Factor (NGF) which repairs damaged nerves and promotes new growth. The Japanese study found that the antioxidant effect of PQQ was 30

times more effective than Vitamins C or E.³ PQQ has also been shown to delay the shrinking of the brain with age.

To further support PQQ's brain supportive actions, a more recent study found PQQ supplementation can directly reduce inflammation and improve mitochondrial function in human subjects.⁴ These benefits also make PQQ useful to improve heart function and many other chronic diseases.

HOW MUCH PQQ SHOULD I TAKE?




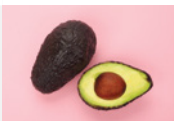
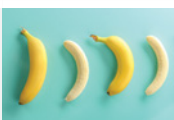



Since PQQ is a vitamin and can't be produced by the body, it must be consumed. The highest amounts are found in foods such as breast milk, cocoa

powder, kiwifruit, papaya, tofu and green peppers. Food sources contain microgram (mcg) doses (i.e. an average kiwi fruit contains 2mcg of PQQ) which may be enough to prevent deficiency as part of a healthy diet. These doses are similar to other water-soluble B vitamins such as folic acid, but to get therapeutic benefits the existing research used doses of 20mg (not mcg) or more. In neurological conditions or chronic health issues, larger milligram doses will most likely be needed.

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4. Harris CB, Chowanadisai W, Mishchuk DO, et al. Dietary pyrroloquinoline quinone (PQQ) alters indicators of inflammation and mitochondrial-related metabolism in human subjects. *J Nutr Biochem*. 2013;24(12):2076-2084.

HOW TO GET THE B'S YOU NEED

VITAMIN	NAME	DIETARY SOURCES	
B1	Thiamin	Sunflower Seeds, Beans, Peas, Eggs, Potatoes, Oats	
B2	Riboflavin	Dairy Products, Soy Beans, Bananas, Mushrooms, Almonds	
B3	Niacin	Meat, Fish, Eggs, Tree Nuts, Brown Rice	
B5	Pantothenic Acid	Shiitake, Broccoli, Avocados, Yogurt, Lentils, Poultry	
B6	Pyridoxine	Tuna, Poultry, Vegetables, Tree Nuts, Bananas	
B7	Biotin	Egg Yolk, Peanuts, Leafy Greens, Onions, Fish, Walnuts, Carrots	
B9	Folic Acid	Lentils, Leafy Greens, Broccoli, Beans, Whole Grains	
B12	Cobalamin	Poultry, Fish, Eggs, Cow's Milk, Yogurt	

ADVANCED B COMPLEX

DESCRIPTION | This family of eight essential B-vitamins is responsible for creating and sustaining your body's energy supply by helping to break down proteins, fats and carbohydrates. With B-vitamins involved in so many of the body's operations, it's easy to see how any shortfall can easily affect how well you feel on a given day. This formulation is particularly advantageous if you follow a vegetarian or vegan diet which might leave you short on B's.

MAIN APPLICATIONS

- *Foundational Nutrition*
- *Energy*
- *Stress*
- *Methylation*

DELIVERY METHOD | Vegetarian Capsules

MEDICINAL INGREDIENTS

Vitamin B1 (Benfotiamine)	100 mg
Vitamin B2 (Riboflavin-5-phosphate sodium)	7.5 mg
Vitamin B3 (Niacin - from 388 mg inositol hexanicotinate)	353 mg
Vitamin B5 (Pantethine, calcium D-pantothenate)	300 mg
Vitamin B6 (Pyridoxal-5'-phosphate)	100 mg
Vitamin B12 (Methylcobalamin)	1000 mcg
Folic acid (calcium L-5-MTHF)	1000 mcg
Biotin	500 mcg
Choline bitartrate (provides 240 mg of choline)	600 mg
Inositol (from inositol hexanicotinate, inositol)	393 mg†

AOR ADVANTAGE

- *Biologically Active Forms*
- *Balanced Ratios*
- *Research-backed Doses*

ADVANCED B COMPLEX ULTRA

DESCRIPTION | Based on ABC, providing all of the eight essential B-vitamins, some of them in multiple forms for superior efficacy in the body and added cofactors for more specialized health benefits for the heart, brain, and mitochondria (energy). Furthermore, this formula is enhanced with time-release technology for improved absorption.

MAIN APPLICATIONS

- *Foundational Nutrition*
- *Stress*
- *Energy*
- *Heart Health*
- *Cognitive Health*
- *Methylation*

DELIVERY METHOD | Tablets

MEDICINAL INGREDIENTS

Vitamin B1 (Benfotiamine, Sulbutiamine)	100 mg
Vitamin B2 (Riboflavin-5-phosphate sodium)	10 mg
Vitamin B3 (Niacin)	30 mg
Vitamin B5 (calcium D-pantothenate, Pantethine)	300 mg
Vitamin B6 (Pyridoxal-5'-phosphate)	50 mg
B12 (Methylcobalamin, Hydroxocobalamin, Cobamamide)	1000 mcg
Folic acid (calcium L-5-MTHF)	1000 mcg
Biotin	500 mcg
Choline (bitartrate)	246 mg
Myo-Inositol (derived from rice husk)	308 mg
Pyroloquinoline Quinone (disodium salt)	2.5 mg

AOR ADVANTAGE

- *Time-Release Technology for Enhanced Absorption*
- *Biologically Active Forms*
- *Vegan-Friendly*
- *Scientifically-Balanced Ratios and Doses*
- *Additional Heart and Cognitive Health Benefits*

BENFOTIAMINE

DESCRIPTION | Benfotiamine, a naturally-occurring, fat-soluble form of thiamine (Active B1) that has up to 5 times higher absorption than water-soluble forms of thiamine (which are more commonly used in dietary supplements). Thiamine is an essential B-vitamin that plays a key role in many functions throughout the body such as nerve conduction, muscle function, synthesis of genetic material, energy production and antioxidant protection.

MAIN APPLICATIONS

- *Cognitive Health*
- *Helps relieve painful symptoms of diabetic neuropathy*
- *Essential for Glucose Metabolism*
- *Thiamine Deficiency*

DELIVERY METHOD | Vegetarian Capsules

MEDICINAL INGREDIENTS

Vitamin B1 (Benfotiamine)	80 mg
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AOR ADVANTAGE

- *Fat soluble form of B1 (Benfotiamine) for better absorption*
- *Vegan-Friendly*

BIOFOLATE

DESCRIPTION | BioFolate combined the active coenzyme form of vitamin-B12 (methylcobalamin), with an active form of folate (L-5-methyltetrahydrofolate). This bioactive formula bypasses normal absorptive mechanisms for vitamin-B12 and folate, which may be lacking due to aging, diet, gastrointestinal issues, or methylation polymorphisms (genetic mutations).

MAIN APPLICATIONS

- *DNA Synthesis*
- *Pregnancy*
- *Cardiovascular Health*
- *MTHFR mutations*
- *Cognitive Health*
- *Methylation*

DELIVERY METHOD | Vegetarian Capsule

MEDICINAL INGREDIENTS

L-5-Methyltetrahydrofolate	1 mg
Vitamin B12 (Methylcobalamin)	2.8 mg

AOR ADVANTAGE

- *Biologically Active Forms of both B9 (folate) and B12 (methylcobalamin)*
- *Combined due to interdependent relationship. Folic Acid and B12 play methyl group "ping pong" with each other, fulfilling respective responsibilities in methionine synthase. A vitamin B-12 could lead to an indirect folic acid deficiency even if enough folic acid is provided for the body; it cannot be used unless a supply of B12 is present.*
- *Vegan-Friendly*

HYDROXY B12

DESCRIPTION | Not only does hydroxocobalamin easily convert to methylcobalamin (a coenzyme form of B12 utilized within the body), but it is also well tolerated by individuals who have trouble taking "pre-methylated" B-vitamins. It also has the unique benefit of helping to support healthy cellular detoxification. This makes it a great option for individuals who are looking for a non-methylated alternative to the more common cyanocobalamin form of B12.

MAIN APPLICATIONS

- *Supports Detoxification Pathways*
- *Forms healthy red blood cells*
- *Anti-dote for Cyanide Poisoning*
- *Metabolize carbohydrates, fats and proteins*
- *For 'overmethylators' or those sensitive to methylated b-vitamins*
- *Vitamin B12 Deficiency (pernicious anemia)*

DELIVERY METHOD | Sublingual Lozenge

MEDICINAL INGREDIENTS

Vitamin B12 (Hydroxocobalamin)	1000 mcg
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AOR ADVANTAGE

- *Enhanced Absorbability*
- *Vegan-Friendly*

METHYLCOBALAMIN

DESCRIPTION | Methylcobalamin (Vitamin-B12) is an essential vitamin for energy and feeling your best, especially during stressful times. B12 is a critical nutrient that helps to support the brain and nervous system. Methylcobalamin may also help normalize sleep-wake cycles, providing a better quality sleep for some.

MAIN APPLICATIONS

- *Cognitive Health*
- *Nerve Function*
- *Foundational Health (Stress/Energy)*
- *B12 Deficiency (pernicious anemia)*
- *Methylation*

DELIVERY METHOD | Sublingual Lozenge

MEDICINAL INGREDIENTS

Vitamin B12 (Methylcobalamin) 5 mg

AOR ADVANTAGE

- *Highly absorbable, works fast, and can be easily used by the body*
- *Bioactive form of B12 (methylcobalamin)*
- *Vegan-Friendly*

METHYLCOBALAMIN ULTRA

DESCRIPTION | High dose Vitamin-B12 in its most effective form in a pleasant tasting sublingual lozenge intended for superior absorption. B12 is a critical nutrient, which helps to support healthy brain function, nerves and energy levels. Methylcobalamin Ultra may also help normalize sleep-wake cycles, providing a better quality sleep for some.

MAIN APPLICATIONS

- *Cognitive Health*
- *Nerve Function*
- *Foundational Health (Stress/Energy)*
- *B12 Deficiency (pernicious anemia)*
- *Methylation*

DELIVERY METHOD | Sublingual Lozenge

MEDICINAL INGREDIENTS

Vitamin B12 (Methylcobalamin) 15 mg

AOR ADVANTAGE

- *Ultra-high, clinically effective dosage of the most bioavailable form of vitamin B12*
- *Sublingual Delivery for improved absorption*
- *Vegan-Friendly*

MAXMETHYL

DESCRIPTION | This carefully crafted formula promotes and enhances the methylation process that is essential for the proper function of almost all of your body's systems. Methylation occurs billions of times every second; it helps repair DNA; it controls homocysteine (an unhealthy compound that can damage blood vessels); helps recycle molecules needed for detoxification; helps maintain mood and keep inflammation in check.

MAIN APPLICATIONS

- *Methylation*
- *Cardiovascular Health*
- *Homocysteine*
- *MTHFR Mutations*
- *Anti-Aging*

DELIVERY METHOD | Vegetarian Capsule

MEDICINAL INGREDIENTS

Trimethylglycine (betaine anhydrous)	500 mg
Folic acid (calcium L-5-MTHF)	267 mg
Vitamin B6 (Pyridoxal-5'-phosphate)	17 mg
Vitamin B12 (Methylcobalamin)	216 mg

AOR ADVANTAGE

- *Contains all the cofactors and methyl donors needed to promote methylation and convert homocysteine into useful amino acids*
- *Contains biologically active forms of all B-vitamins*
- *Safe for those with MTHFR mutations*

TRI B12 SYNERGY

DESCRIPTION | B12 is an essential vitamin we all need to feel our best and have energy to live and thrive. Tri B12 Synergy is a highly absorbable blend of Methylcobalamin, Hydroxycobalamin and Adenosylcobalamin. Each of these three forms of cobalamin is independently supportive of and required for different cellular processes.

MAIN APPLICATIONS

- *Foundational Nutrition*
- *Cardiovascular Support*
- *Neurological Health*
- *Ideal for high risk groups or sensitive bodies*
- *Vitamin B12 Deficiency (pernicious anemia)*
- *Methylation*

DELIVERY METHOD | Lozenge

MEDICINAL INGREDIENTS

Vitamin B12 (Methylcobalamin)	3.5 mg
Vitamin B12 (Hydroxocobalamin)	1 mg
Vitamin B12 (Adenosylcobalamin)	500 mcg

AOR ADVANTAGE

- *Manufactured using safe, ISO and eco - certified environmentally innocuous processes that ensure an outstandingly pure product*
- *The first to combine AdeCbl/MetCbl/HydCbl offering superior benefits and should be considered first line of defense against conditions that may benefit from B12*
- *Ideal for hypersensitive bodies, or benign allergy-like symptoms (not having the right blend of B12 can have the potential to trigger an overreaction in a sensitive body)*

P-5-P

DESCRIPTION | Pyridoxal-5-Phosphate is the active form of Vitamin B6. It is a coenzyme that drives approximately 168 vital enzyme processes in our body. Among them, P-5-P facilitates a process known as deamination—which is responsible for converting essential amino acids into non-essential ones. P-5-P also helps shuttle certain nutrients—such as magnesium—across cellular membranes that helps increase absorption rates. Pyridoxal 5-Phosphate is vital to our health, yet is often absent in our diets.

MAIN APPLICATIONS

- *Heart Health*
- *Hormonal Health*
- *Mood*
- *Cognitive Health*
- *Immune Support*
- *Skin Health*
- *Methylation*

DELIVERY METHOD | Vegetarian Capsule

MEDICINAL INGREDIENTS

Vitamin B6 (Pyridoxal-5'-phosphate) 50 mg

AOR ADVANTAGE

- *Active form of B6 for enhanced absorption and effectiveness*

PANTHETHINE

DESCRIPTION | Pantethine is the active form of vitamin B5. It is a critical factor in cellular energy production, phase II detoxification, and the synthesis of numerous important sex and adrenal hormones, and neurotransmitters. Research shows that Pantethine helps support healthy cholesterol levels.

MAIN APPLICATIONS

- *Heart Health (cholesterol)*
- *Adrenal Function*
- *Detoxification*
- *Liver Health*
- *Energy*

DELIVERY METHOD | Vegetarian Capsules

MEDICINAL INGREDIENTS

Pantethine 300 mg

AOR ADVANTAGE

- *First to offer Canadian stand-alone Vitamin B-5 in the form of Pantethine*
- *Pure, effective form of Vitamin B-5*
- *Research-supported dose*



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