



MULTIVITAMIN

Scientific Research

Most often we challenge our bodies to a nutrient demanding lifestyle, burdened with stress factors like chronic mental or emotional stress, chronic intense exercise, cigarette smoking, excessive use of alcohol, restrictive diets, polluted environments and cancer causing chemicals. Subsequently, this increases our risk for chronic illness and encourages the long-term use of medication, which might further increase nutrient requirements.

PSNLifestyle Multivitamin provides a comprehensive synergy of high quality vitamins and minerals, which supports a nutrient demanding lifestyle and encourages efficiency of all body systems and functions.

Vitamin A as beta-carotene: Of all the carotenes, beta-carotene is the most nutritionally active source of Vitamin A without the risk of supplemental Vitamin A toxicity. Research proves that beta-carotene is not cancer forming, is not toxic to the embryo and does not cause toxic hypervitaminosis which is associated with vitamin A overloading (1). Vitamin A is required for reproduction, foetal development, healthy epithelial tissue (of the skin, uterus, gastrointestinal tract and lungs), vision and cell development. Via its anti-cancer and powerful antioxidant properties, beta-carotene has been shown to enhance cancer resistance, protecting against various cancers particularly lung-, digestive tract- and skin cancer (2,3). Vitamin A deficiency can be caused by poor nutrition, malabsorption conditions such as celiac disease, Crohn's disease, pancreatic disorders, iron- and zinc deficiency (8).

Vitamin B1 (Thiamine) is a coenzyme of more than 24 enzymes. It is involved in energy metabolism of fats, carbohydrates and branched chain amino acids (BCAA's) to supply fuel for body functions, muscle activity and especially brain function. Vitamin B1 promotes the production of neurotransmitters GABA, acetylcholine and glutamate. It also imitates acetylcholine, which is the main neurotransmitter involved in memory and learning, and therefore demonstrates beneficial potential for the treatment of Alzheimer's disease and dementia (16). Intensive physical activity stresses these metabolic pathways and physical training can increase the requirement for thiamine (17). Although the risk of thiamine deficiency is rare,

deficiency can occur due to diets that mainly consist of refined carbohydrates (sugar/refined wheat flour products), chronic alcohol abuse, aging, gastro-intestinal surgery severe infections, cancer, long-term use of diuretic medications, and intensive long-term physical activity (15,17).

Vitamin B2 (Riboflavin) is involved in metabolism of glucose, fatty acids, glycerol and amino acids for energy. It is particularly important for tissue repair, healthy vision and the integrity of blood. It also protects against DNA damage, which can lead to cancer. Riboflavin intake worldwide seems to be low and requirements might be increased by long term physical exercise and restrictive diets (18).

Vitamin B3 (Niacinamide) is essential in various biochemical processes in the body. Niacinamide displays significant antioxidant and anti-inflammatory properties. It prevents nicotinamide adenine dinucleotide (NAD) depletion and inhibits free radical formation, which causes oxidative damage. NAD is a biological molecule that participates in many biological reactions like regulation of energy metabolism, gene transcription and DNA repair. NAD is an important regulator of longevity and disease. Niacinamide protects against diabetes by providing protection against macrophage toxins (19), supporting pancreatic beta-cell regeneration (20) and protecting pancreatic islet cells against potential damage from free radicals and nitric oxide (21). It also stimulates neurotransmitter GABA receptors, which promotes a relaxed state of mind (22).

Vitamin B5 (D-Calcium Pantothenate) is used in the synthesis of coenzyme A, which is essential to sustain life. It is important in energy metabolism and synthesis of fatty acids, regulation of cholesterol and production of acetylcholine (23). Acetylcholine is a neurotransmitter which is released by nerve cells to activate muscle contraction. It also plays a role in brain function and autonomic nervous system function, which controls unconscious body functions. Low levels of Vitamin B5 can be caused by factors like insufficient dietary intake and the use of oral contraceptives. Research demonstrates that Vitamin B5 treatment may be beneficial for conditions like acne (87), hair loss, greying of hair (88), hepatitis A (89), hyperlipidaemia (90), obesity (91) and symptoms related to osteo- and rheumatoid arthritis like morning stiffness and associated disability (92). Vitamin B5 provides protection against toxicity caused by exposure to certain chemicals (93), protects the adrenal glands against exhaustion and depletion, caused by severe stress (94) and may benefit exercise performance by decreasing blood lactate levels and oxygen consumption during prolonged exercise (95).

Vitamin B6 (Pyridoxine Hydrochloride) is required for regulation of almost all biochemical functions in the body including amino acid metabolism, synthesis of neurotransmitters, glycogen and fatty acid metabolism, hormone metabolism and haemoglobin formation (96). Deficiency can be caused by the use of oral contraceptives and cigarette smoking. Deficiency exists at an average occurrence of 25% in adults. Pyridoxine supplementation is used for treatment of premenstrual syndrome, heart disease, high cholesterol, diabetic nerve damage and impaired immunity (18).

Vitamin B12 (Methylcobalamin) is critical for various functions in the body, including DNA synthesis, formation of the nerve cell sheath and nervous system function, as well as for synthesis of rapidly dividing tissues like the gastric lining and blood cells. Vitamin B12 as supplement, exists in two main forms, with one being Methylcobalamin and the other, cyanocobalamin. Cyanocobalamin is the most common form of Vitamin B supplementation. It is chemically synthesized and only 1% of it is converted into active Methylcobalamin in the body (28). Methylcobalamin is an active form of Vitamin B12 and with its methyl group, it has been found

effective in the treatment of autism, cognitive decline and cardiovascular disease risk (29,30). It does not require intrinsic factor for absorption and thus has a higher bioavailability than cyanocobalamin and longer tissue retention (31,32). Vitamin B12 deficiency or anaemia is common (up to 62% at the age of 65) and can lead to neurological and psychiatric disorders. Deficiency is related to a vegetarian diet, excessive alcohol intake, aging, pregnancy, haemolytic anaemia, blood loss, gastrointestinal inflammation, cancer, Alzheimer's disease, certain medications and liver or kidney disease (27). Supplementation, in case of deficiency, can benefit various physiological imbalances like depression (24), impaired mental health (30), the risk of stroke (25), cardiovascular health (29), diabetic neuropathy (97), heart rate irregularity (98), male impotence (99), sleep disturbance (100) and immunity (26).

Biotin is part of the B vitamin group and is an essential cofactor to enzymes in intermediary metabolism, which can be defined as the process by which nutrients are converted to cellular components. Deficiency can be caused by prolonged consumption of raw egg white, pregnancy, liver disease, anti-seizure medications and inherited metabolic deficiencies. Deficiency of biotin can be associated with signs like hair loss, conjunctivitis, dermatitis, mental and emotional symptoms like depression, lethargy, numbness and tingling of the extremities. Disorders that may benefit from biotin supplementation include chronic candidiasis (64), dermatitis (63), diabetes (62), brittle nails (60) and dyslipidaemia (61).

Vitamin C is a powerful antioxidant. It is involved in protein metabolism and required for the synthesis of collagen, the main structural protein. Collagen forms part of connective tissue in tendons, blood vessels, bones, gut, teeth and skin. Vitamin C is also involved in synthesis of L-carnitine and neurotransmitters (33,34) and is required for the conservation of healthy bones (35), healthy immune function (36,37) and cardiovascular health (38,39). People who are at risk of vitamin C deficiency include, smokers and passive smokers, infants fed evaporated or boiled milk, people with inadequate dietary intake and those with intestinal malabsorption.

Vitamin D3 (the natural form), exerts a particularly important role in assimilation of

phosphorus and calcium, vital for bone formation and growth. Vitamin D also plays an important role in reproductive and hormonal health, digestive function and emotional wellbeing. It is supported by research, affirming its protective role against various types of cancers, low bone mineral density and osteoporosis, mental disorders, multiple sclerosis, autoimmune disease, diabetes, cholesterol, high blood pressure, tooth decay and gum disease, and muscle weakness (4-7). Vitamin D deficiency is fairly common, especially in vegetarians, the elderly, individuals who have limited exposure to direct sunlight and those with dark skin pigmentation.

Vitamin E: One of the most prominent roles of vitamin E, is its anti-oxidant protection against oxidative damage to cell membranes and DNA. It therefore provides protection against the risk of cancer (12), but also supports healthy immune function and cardiovascular health (9) and plays an important role in reducing the risk of blood clot formation (9), cataracts (10) and exercise induced muscle injury (11).

Vitamin K is vital for normal blood clotting as well as healthy bone metabolism and development (14). Research demonstrates that vitamin K helps to maintain healthy bone density and decreases the risk of osteoporosis (13), especially during the postmenopausal phase (13).

Folic acid is required for metabolism of amino acids, synthesis of nucleic acids for DNA and RNA, and enzyme cofactors (40). Folate deficiency can be a risk factor in smokers, heavy coffee drinkers, pregnant women, adolescent girls, new-born babies and the elderly. Deficiency is associated with birth defects, atherosclerosis due to elevated homocysteine levels (42), neuropsychiatric disorders like insomnia, restless leg syndrome, dementia, irritability, depression and peripheral neuropathy (41).

Chromium is a trace element, which plays a key role in insulin regulation and metabolism of fats like cholesterol and sugars (43,44). It has also been reported to reduce inflammation (85) and activate specific immune responses (86). Strenuous exercise, physical or emotional stress, illness and aging can increase chromium requirements. Particularly in developed countries, insufficient intake of chromium is associated with

aging, diabetes and atherosclerosis or cardiovascular disease.

Copper is an essential element and is most prevalent in the liver where it forms part of energy and detoxification processes. Copper is also required for assimilation and synthesis of haemoglobin, for the integrity of the nerve sheaths, metabolism of vitamin C, oxidation of fatty acids as well as for immune system regulation. Copper imbalances are associated with bone and joint instabilities, aging, skin problems, anaemia, neurological imbalances and cardiovascular degeneration (46). Copper deficiency is rare, but can result from factors like malnutrition, malabsorption, excessive fructose consumption and excessive zinc supplementation. Deficiency is associated with impaired immunity, decreased bone density, neurodegeneration and cardiovascular disease.

Iodine is a vital nutrient necessary for growth and development during all stages of life, especially during foetal development and early childhood. Iodine is stored in the thyroid gland where it is incorporated into synthesis of thyroid hormones which regulates metabolic activity. Iodine supplementation is also supported by research to have anti-inflammatory properties by decreasing C-reactive protein and interleukin-6 (48). Iodine deficiency is very common, especially in Europe. Iodine deficiency in Africa was a great health concern about 70 years ago and in 1954 an iodised salt programme was implemented to treat the deficiency and is still in process today. Severe iodine deficiency can lead to hypothyroidism, infertility, increased prenatal death, goitre and cretinism as well as mental retardation (47).

Iron is crucial for human life. It is required for haemoglobin synthesis in red blood cells, myoglobin production in the heart and skeletal muscles, and for enzymes needed for energy metabolism and DNA synthesis (101). Iron deficiency is one of the most common deficiencies in the world and is linked to decreased oxygen transport (decreased haemoglobin) and thus poor muscle function (49), poor temperature regulation (50), increased metabolism of adrenal hormones (52) and decreased thyroid metabolism (53). Symptoms of iron deficiency include fatigue, paleness, impaired immune function, intolerance to cold, irritability and a general lack of wellbeing (46).

Manganese is mostly found in the bone, pancreas, liver and kidneys. Amongst zinc and copper, it is a cofactor of super oxide dismutase (SOD), an enzyme which repairs and protects cells from free radical damage caused by superoxide. Superoxide is the most common free radical in the body and is produced during food metabolism and by immune cells. SOD protects cell membranes against lipid peroxidation, radiation and chemical induced carcinogenesis, reperfusion injury and inflammation (56-59). Low levels of SOD are associated with manganese deficiency. Factors like ozone, alcohol, high polyunsaturated fat diet and oxidative stress caused by factors like high intensity exercise, can increase the requirement for SOD and thus manganese. Except from its involvement in antioxidant protection, manganese also plays a vital role in cellular energy production, brain and nerve function, immune function, reproductive function, fat and carbohydrate metabolism and formation of bone and cartilage (55). Decreased levels of manganese have been found in epileptics, diabetes and osteoporosis.

Molybdenum is an essential trace element and a cofactor for three enzymatic reactions that take place in almost all life forms. Molybdenum supplementation has been reported to be beneficial in the treatment of sulphite sensitivity (preservatives in foods and beverages like wine, beer and soft drinks) (68,69), Wilson's disease or copper toxicity (70) and cancer (71). Its deficiency is rare, but can occur in genetic metabolic disorders or where dietary intake is insufficient.

Selenium methionine is considerably better absorbed in the body than the inorganic forms of selenium like selenite. Selenium is a cofactor for enzymes and proteins, has substantial importance as an antioxidant and plays a vital role in thyroid function, insulin regulation, cell growth

and fertility (72). Via its powerful antioxidant effects, selenium is supported by research for its significantly beneficial effect on cancer risk. In a study on 1312 individuals, daily selenium supplementation at triple the RDA, demonstrated 63% fewer cases of prostate cancer, 58% fewer colon and rectal cancer cases and 47% fewer lung cancer cases with a 50% decreased incidence of cancer related deaths compared to the placebo group (73). Low blood levels of selenium have been implicated in liver disease (74), rheumatoid arthritis (75), cardiovascular disease (76), asthma (77), myotonic dystrophy (78), male infertility (79), heavy metal toxicity (80), low thyroid function (81), cataracts (82), food intolerance (83) and depressed mood (84).

Zinc is an essential mineral, vital for a multitude of biochemical processes and for the function of more than 300 enzymes. Zinc is crucial for growth and replication of cells including foetal and embryonic cells, nerve cells, gastrointestinal tissue and immune cells. Zinc is required for insulin activity (67) and may affect body composition through its interaction with various hormones including thyroid hormones, androgens and growth hormone. Most facets of reproduction require zinc (65). It is also vital for healthy immune function (66) and healthy brain function. Chronic zinc deficiency can cause various mental imbalances like fatigue, depression, unstable moods, impaired concentration and reasoning (45). Deficiency is also associated with growth impairment, impaired hormonal functions (65), infertility, poor memory and weak immune function. The prevalence of zinc deficiency has been found to be higher in individuals with high levels of physical activity, those with insufficient dietary intake, in smokers, those with excessive alcohol consumption, vegetarians, long-term water consumption from copper pipes, highly restrictive diets (45), as well as in individuals with injuries, infections or illness which requires tissue repair.

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