

Therapeutic Nutrient Use in Disorders & Diseases

Poor Energy Production

Vitamin B₁

- Thiamine is required for the conversion of pyruvate to acetyl CoA, which enters the Krebs cycle to produce energy. (Clift 2003)
- Thiamine is required to metabolise alpha-ketoglutarate to generate nicotinamide adenine dinucleotide phosphate (NADP) for energy production. (Groff et al 2000, Mahan et al 2000)

Vitamin B₂

- Riboflavin is required to form certain coenzymes needed in the metabolism of carbohydrates, amino acids and fatty acids. (Groff et al 2000, Mahan et al 2000)
- Riboflavin is a component of flavin mononucleotide (FMN) and flavin adenine dinucleotide (FAD), which function as coenzymes in oxidation-reduction reactions in energy production, the metabolism of pyruvate, beta oxidation of fatty acids, and the conversion of succinate to fumarate in the Krebs cycle. The electrons synthesised from these pathways are then converted into ATP in the electron transport chain. (Groff et al 2000, Wardlaw 1999)

Vitamin B₃

- Nicotinic acid is a component of nicotinamide adenine dinucleotide (NAD) and nicotinamide adenine dinucleotide phosphate (NADP), which function as coenzymes in oxidation-reduction reactions in energy production. (Groff et al 2000)
- NADH synthesised from NAD, transports electrons from the Krebs cycle to the electron transport chain to produce ATP for energy. (Groff et al 2000)
- NAD is reduced in glycolysis, oxidative decarboxylation of pyruvate, beta-oxidation of fatty acids and oxidation of ethanol. (Groff et al 2000)

Vitamin B₅

- Pantothenic acid is a component of coenzyme A (CoA) and acyl-carrier protein (ACP), which function as acyl group carriers in the use of carbohydrates, amino acids and fatty acids to produce energy. (Garrow et al 2000, Mahan et al 2000, Murray et al 1998)
- CoA combines with two carbon acetate groups from beta-oxidation of fatty acids to form acetyl CoA, which is then able to enter the Krebs cycle for energy production. (Clift 2003)
- CoA is required for the beta-oxidation of fatty acids and the oxidative degradation of amino acids. The products produced in these processes then enter the Krebs cycle to produce energy. (Garrow et al 2000, Groff et al 2000, Mahan et al 2000, Shils et al 1999, Wardlaw 1999)
- CoA may promote gluconeogenesis to produce energy. (Garrow et al 2000)

Vitamin B₆

- Pyridoxal phosphate is the coenzyme for glycogen phosphorylase, which promotes glycogenolysis for energy production. (Garrow et al 2000, Groff et al 2000, Mahan et al 2000, Shils et al 1999)

Folic acid, Vitamin B₁₂

- These act as coenzymes that participate in the metabolism of amino acids by transferring methyl groups during energy production.
- Vitamin B12 is required to transport oxygen in the blood and is thus essential for energy production. (Holford 1997)

Biotin

- It functions as a coenzyme for pyruvate carboxylase and acetyl-coA carboxylase, which are essential for gluconeogenesis and fatty acid synthesis, which form two of the major fuel sources for the body.
- It is also the coenzyme for propionyl-CoA carboxylase, which catalyses the beta-oxidation of fatty acids to produce methylmalonyl-CoA for the Krebs cycle and to produce glucose. (Garrow et al 2000, Groff et al 2000, Mahan et al 2000, Wardlaw 1999)

Vitamin C

- It acts as a cofactor for enzymes involved in the conversion of food to energy. (Holford 1997)

Zinc

- Zinc is required in the production, storage and release of insulin by the islet of Langerhan cells. In turn, insulin helps to regulate the body's energy supply by transporting glucose from the blood to the cells to be metabolised. (Holford 1997, NC 2003)

Magnesium

- Functions as a cofactor for enzymes in more than 300 bodily reactions including glycolysis, the Krebs cycle, beta-oxidation, fatty acid metabolism, gluconeogenesis and ATP production. (Groff et al 2000, Shils et al 1999)
- Participates in ATP production by attaching to ATP between the 2nd and 3rd phosphate groups to stabilise the bond and create active ATP. (Clift 2003)
- Acts synergistically with zinc and pyridoxine in many enzyme reactions, including the metabolism of proteins and carbohydrates. (NC 2003)

Chromium

- It is an intrinsic component of the glucose tolerant factor, which facilitates the binding of insulin to its receptor sites. This in turn helps to transport glucose from the blood to the cells to be metabolised to form energy. (Holford 1997, NC 2003)
- Chromium also participates in lipid and protein metabolism and in the function of some enzymatic reactions. (NC 2003)

Coenzyme Q₁₀

- Coenzyme Q₁₀ is essential for virtually all energy production, by transferring electrons in the energy cycle in the mitochondria of the cell to generate ATP. (WHMD)
- Helps ensure overall stamina so as to fight off frequently debilitating disorders such as chronic fatigue. (WHMD)

Poor Energy Production

Micronutrients	Therapeutic Dose for Adults (per day)	Cautions and Contraindications
Vitamin B ₁	5 – 100 mg	<ul style="list-style-type: none"> - Massive doses may suppress respiratory function and cause death. (Mahan et al 2000) - Very high doses may cause headaches, convulsions, muscular weakness, cardiac arrhythmia and allergies. (Groff et al 2000) - High doses may inhibit the use of other B vitamins. (Kirschmann et al 1996)
Vitamin B ₂	10 – 40 mg	<ul style="list-style-type: none"> - No known toxicity. (Groff et al 2000, Holford 1997)
Vitamin B ₃	100 – 3000 mg	<ul style="list-style-type: none"> - A flush may occur. (Murray et al 1998) - More than 1000mg daily may cause GIT problems. (Groff et al 2000) - Should not be given to those with liver disease, elevated uric acid levels, gout and dysfunctional pancreatic beta cells. (Groff et al 2000)
Vitamin B ₅	20 – 200 mg	<ul style="list-style-type: none"> - Massive doses may induce intestinal disturbance. (Groff et al 2000) - 100g daily may increase niacin excretion. (Groff et al 2000)
Vitamin B ₆	10 – 150 mg	<ul style="list-style-type: none"> - 500 mg daily may cause neurotoxicity. (Groff et al 2000) - Excessive doses may cause sensory neuropathy. (Groff et al 2000)
Vitamin B ₁₂	800 – 3000 mcg	<ul style="list-style-type: none"> - No known toxicity. (Holford 1997)
Folic Acid	1000 – 5000 mcg	<ul style="list-style-type: none"> - 5 mg daily may mask a vitamin B₁₂ deficiency. (Groff et al 2000) - 1 – 10 mg daily may cause allergic reactions. (Wardlaw 1999) - 15 mg daily may cause insomnia and GIT distress. (Groff et al 2000)
Biotin	500 – 5000 mcg	<ul style="list-style-type: none"> - No known toxicity. (Mahan et al 2000)
Vitamin C (Ascorbic acid)	250 – 10000 mg	<ul style="list-style-type: none"> - Excessive doses may lead to bowel looseness. (Holford 1997) - May aggravate dyspepsia and gastric ulcers. (Clift 2003) - Use cautiously with anticoagulants. e.g. warfarin (Clift 2003)
Zinc	10 – 100 mg	<ul style="list-style-type: none"> - Excessive doses may suppress immunity, cause vomiting, reduce HDL levels, increase cardiovascular disease, decrease iron and copper levels. (Balch et al 1997, Cataldo et al 1995, Holford 1997, Wardlaw 1999)
Magnesium	300 – 1000 mg	<ul style="list-style-type: none"> - None below 1000 mg. (Holford 1997) - With chronic use of magnesium containing drugs, hypermagnesaemia may occur in those with renal insufficiency. (Clift 2003)
Chromium	20 – 200 mcg	<ul style="list-style-type: none"> - Toxicity only occurs above 1000 mg, 10000X the top therapeutic level. (Holford 1997)
Coenzyme Q ₁₀	10 – 90 mg	<ul style="list-style-type: none"> - No known toxicity. (Holford 1997)

Liver Disorders

B Complex: The B vitamins are important for proper digestion, absorption of nutrients and play a vital role in maintaining healthy liver function.

Vitamin B₅

- Detoxifies drugs and xenobiotics in the liver. (Groff et al 2000)
- Shown to protect rats from peroxidation and liver damage cause by carbon tetrachloride. (Shils et al 1999)

Vitamin B₆

- Plays a role in transamination reactions and promotes the optimal function of choline and methionine. (Metagenics 2001)
- Deactivated by liver dephosphatase enzymes; an increased intake thus helps to prevent a deficiency. (Osiecki 1990)

Folic acid, Vitamin B₁₂

- Essential cofactors in methylation, working synergistically with choline, betaine and SAM (S-adenosylmethionine) as lipotropic agents, which increases the liver's ability to regulate plasma lipids, synthesise bile, metabolise dietary fats and promote the detoxification of fat-soluble chemicals and hormonal residues. (Murray et al 1998, Shils et al 1999)

Vitamin C

- Vitamin C is a powerful antioxidant that neutralises toxic substances and thus reduce the detoxifying workload of the liver.
- It is also a potent anti-viral agent that supports immunity against infections. According to Robert Cathcart, M.D., "acute hepatitis is one of the easiest diseases to cure using vitamin C." High doses were shown to greatly decrease acute viral hepatitis in two to four days. (Cathcart 1981, 1992)
- Glutathione is a powerful detoxifier and antioxidant that protects against liver cancer and other degenerative liver disease. However, studies have shown that the systemic availability of the oral administration of glutathione is negligible. (Witschi et al 1992) In contrast, research has shown that vitamin C increases glutathione levels by helping the body to manufacture it. In one double-blind study, the average red blood cell glutathione concentration in patients who were administered 500 mg per day of vitamin C rose by almost 50 percent. (Johnston et al 1993)

*Administer vitamin C with bioflavonoids, which promotes the uptake of vitamin C, protects it from oxidation and inhibits its conversion to its less active forms. (Bland 1995)

Choline

- A lipotropic agent that helps to promote the flow of fat and bile to and from the liver, producing a "decongesting" effect on the liver and promoting improved liver function and fat metabolism. (Balch et al 1997, Murray et al 1998)
- Oxidised to betaine, which donates a methyl group to homocysteine to produce methionine (Clift 2003). Methionine is in turn converted to SAM, the major lipotropic compound in the liver. (Murray et al 1998)
- Important for energy production in the liver. (Balch et al 1997)

Inositol

- Reverses liver disorders by acting as a lipotropic agent that helps to export fat from the liver. (Murray et al 1998)

Betaine

- Reverses liver disorders by acting as a lipotropic agent that helps to export fat from the liver. (Metagenics 2001)

Methionine

- A good source of sulphur, which inactivates free radicals, thus promoting liver detoxification. (Balch et al 1997)
- Increases the levels of SAM, the major lipotropic compound in the liver. (Murray et al 1998)
- Methionine also has lipotropic ability, which helps to reduce excessive deposits of fat in the liver. (Murray et al 1998)
- Methionine protects and promotes the synthesis of glutathione, preventing its depletion during toxic overload. Since glutathione is vital for liver detoxification, this protects the liver from the damaging effects of toxic substances. (Balch et al 1997, Murray et al 1998)
- Adequate levels of methionine promote sulfation, which in turn enhances Phase II detoxification by decreasing toxicity and increasing the water-solubility of toxins. (Murray et al 1998)
- Methionine also serves as a chelator of heavy metals, helping to detoxify harmful heavy metals like lead. (Balch et al 1997, Metagenics 2001)
- It is important to use methionine with vitamin B₆, folic acid, vitamin B₁₂, betaine and choline as these nutrients promote the proper metabolism of methionine and thus prevent the accumulation of toxic homocysteine, which has been associated with cardiovascular disease and Alzheimer's disease. (Wardlaw 1999)

Essential Fatty Acids

- Important in normalising blood circulation to the liver. (Osiecki 1990)

Liver Disorders

Micronutrients	Therapeutic Dose for Adults (per day)	Cautions and Contraindications
Vitamin C (Ascorbic acid)	250 – 10000 mg	<ul style="list-style-type: none"> - Excessive doses may lead to bowel looseness. (Holford 1997) - May aggravate dyspepsia and gastric ulcers. (Clift 2003) - Use cautiously with anticoagulants. e.g. warfarin (Clift 2003)
Vitamin B ₅	20 – 200 mg	<ul style="list-style-type: none"> - Massive doses may induce intestinal disturbance. (Groff et al 2000) - 100g daily may increase niacin excretion. (Groff et al 2000)
Vitamin B ₆	10 – 150 mg	<ul style="list-style-type: none"> - 500 mg daily may cause neurotoxicity. (Groff et al 2000) - Excessive doses may cause sensory neuropathy. (Groff et al 2000)
Vitamin B ₁₂	800 – 3000 mcg	<ul style="list-style-type: none"> - No known toxicity. (Holford 1997)
Folic Acid	1000 – 5000 mcg	<ul style="list-style-type: none"> - 5 mg daily may mask a vitamin B₁₂ deficiency. (Groff et al 2000) - 1 – 10 mg daily may cause allergic reactions. (Wardlaw 1999) - 15 mg daily may cause insomnia and GIT distress. (Groff et al 2000)
Choline	1 – 20 g	<ul style="list-style-type: none"> - Large doses may cause a fishy body odour, gastric distress, vomiting and diarrhoea. (Murray et al 1998, Wardlaw 1999)
Inositol	750 – 3000 mg	<ul style="list-style-type: none"> - No known toxicity. (Murray et al 1998)
Betaine	500 – 1000 mg	<ul style="list-style-type: none"> - Contraindicated for persons suffering from ulcers and high stomach acid, including heartburn. (Flora)
Methionine	1000 mg	<ul style="list-style-type: none"> - Contraindicated in homocystinuria. - Excessive doses could increase its conversion to homocysteine, which is linked to cardiovascular disease and Alzheimer's disease. (Wardlaw 1999)

Supplement: Metagenics – Lipo-Gen

Adrenal Stress

B Complex: The B vitamins are necessary for adrenal function, performing important roles in energy production by acting as co-enzymes within the Krebs's cycle.

Vitamin B₅

- It is known as the anti-stress vitamin because it plays a critical role in the adrenal gland hormone production. (Murray et al 1998, Wardlaw 1999)
- Vitamin B₅ is a precursor to the adrenal steroids and is required for energy production, endurance and stress management. (NC 2003)
- Vitamin B₅ is a vital part of Coenzyme A, which is crucial for the formation of cortisol in the adrenal cortex. Cortisol is in turn, the major adrenal glucocorticoid; it stimulates the conversion of proteins to carbohydrates, raises blood sugar levels and promotes glycogen storage in the liver. (Metagenics 2001)

Vitamin C

- The adrenal glands use ascorbic acid to convert dopamine to adrenaline and noradrenaline in response to low blood glucose, exercise and stress. (Groff et al 2000, Mahan et al 2000)
- If ascorbic acid levels are depleted, dopamine is converted to adrenochrome and noradrenochrome instead. These substances disrupt cellular respiration, increasing oxidative stress and adversely affecting mental health. (Groff et al 2000, Mahan et al 2000)
- Ascorbic acid is required to convert phenylalanine to tyrosine, which is in turn required to produce dopamine, L-dopa, adrenaline, noradrenaline, thyroid hormones and melanin. (Clift 2003)
- Ascorbic acid is also needed to convert tryptophan to 5-hydroxytryptophan, which has anti-epileptic and anti-depressant actions, and serotonin. Serotonin is an important neurotransmitter involved in the control of appetite, sleep, memory and learning, temperature regulation, mood, behaviour, cardiovascular function, muscle contraction, endocrine regulation, and depression. (Groff et al 2000, Mahan et al 2000)

Vitamin E

- Vitamin E concentrates in the adrenal glands and nervous tissue and is required for the protection of these areas from harmful free radicals derived from metabolic by-products. (NC 2003)

Bioflavonoids

- Administer vitamin C with bioflavonoids, which promotes the uptake of vitamin C, protects it from oxidation and inhibits its conversion to its less active forms. (Bland 1995)
- Bioflavonoids also ease pressure on the adrenal glands by decreasing the breakdown of cortisol. (Metagenics 2001)

Coenzyme Q₁₀

- Carries oxygen to the adrenal glands. (Balch et al 1997)

Calcium, Chromium and Manganese

- These minerals aid in the optimum function of the adrenal glands, especially so for chromium, which is found to concentrate in the adrenals.
- Chromium and manganese also promote the proper utilisation of glucose, which may be out of balance in some endocrine disorders. (NC 2003)

Magnesium

- Magnesium is required for the production of ATP, the energy source for all cellular activity. (Clift 2003)

Tyrosine

- Aids adrenal gland function and relieves excessive stress on the adrenal glands, which have the important role of producing steroid hormones. These include aldosterone for mineral balance, glucosteroids which regulate metabolism and improve resistance to stress, and small amounts of androgens. (NC 2003)
- Tyrosine is also an essential component of all the thyroid hormone precursors – diiodothyronine, diiodotyrosine, and monoiodotyrosine – which drive the body's production of energy by increasing its basal metabolic rate. (NC 2003)
- Tyrosine has a thymoleptic effect; having adequate amounts ensures a good supply of noradrenaline in the brain, which in turn elevates mood and lessens depression. (Balch et al 1997)
- It also promotes the production of melanin, the pigment responsible for skin and hair colour. (Balch et al 1997)

*Take with vitamin B₆ and vitamin C for better absorption. (Balch et al 1997)

Adrenal Stress

Micronutrients	Therapeutic Dose for Adults (per day)	Cautions and Contraindications
Vitamin B ₅	20 – 200 mg	<ul style="list-style-type: none"> - Massive doses may induce intestinal disturbance. (Groff et al 2000) - 100g daily may increase niacin excretion. (Groff et al 2000)
Vitamin C (Ascorbic acid)	250 – 10000 mg	<ul style="list-style-type: none"> - Excessive doses may lead to bowel looseness. (Holford 1997) - May aggravate dyspepsia and gastric ulcers. (Clift 2003) - Use cautiously with anticoagulants. e.g. warfarin (Clift 2003)
Vitamin E	100 – 1000 mg	<ul style="list-style-type: none"> - Use cautiously with anticoagulants. e.g. warfarin (Clift 2003) - Use cautiously in hypertension and diabetes. (Clift 2003)
Bioflavonoids	500 – 3000 mg	- No known toxicity. (Bland 1995)
Coenzyme Q ₁₀	10 – 90 mg	- No known toxicity. (Holford 1997)
Calcium	1000 – 2000 mg	<ul style="list-style-type: none"> - Excessive doses may interfere with the absorption of other minerals. (Holford 1997) - Excessive doses may lead to hypercalcemia and consequently calcification of the kidneys, heart and other soft tissues. (Holford 1997, Mahan et al 2000)
Chromium	20 – 200 mcg	<ul style="list-style-type: none"> - None below 1000 mg. (Holford 1997) - Excessive doses could impair zinc absorption. (Whole Heath MD)
Manganese	2.5 – 15 mg	- No known toxicity. (Holford 1997)
Magnesium	300 – 1000 mg	<ul style="list-style-type: none"> - None below 1000 mg. (Holford 1997) - With chronic use of magnesium containing drugs, hypermagnesaemia may occur in those with renal insufficiency. (Clift 2003)
L-Tyrosine	500 mg	<ul style="list-style-type: none"> - Contraindicated in those with alkaptonuria and tyrosinemia type I and type II. (PDR Health) - Contraindicated in those taking non-selective monoamine oxidase (MAO) inhibitors. (PDR Health) - Should be used cautiously by those with hypertension. (PDR Health) - Those with melanoma should avoid L-tyrosine supplements. (PDR Health)

Supplement: Dr Vera's Formulations – Nutri 21

Infertility

Vitamin A

- Vitamin A is essential for maintaining the health of the cilia in the fallopian tubes, the health of the testes, for sperm production, and it also aids zinc metabolism – all of which are important for improving fertility. (Werbach 1999)
- Vitamin A helps to reduce the risks of malformation and congenital abnormalities. (Werbach 1999)

Vitamin B₁₂

- Vitamin B₁₂ is required for the replication of cells, and thus adequate amounts should be taken to avoid reduced sperm counts and depressed sperm motility. (Murray et al 1998)

Vitamin C

- Sperm is very susceptible to free radical damage. Vitamin C specifically protects the sperm against damage by protecting its genetic material (DNA). (Murray et al 1998)
 - In response to infection, the immune system produces antibodies that bind to sperm. This leads to agglutinated sperm, which reduces fertility rates. Vitamin C improves fertility by reducing antibody production, and hence the amount of agglutinated sperm. This prevents the sperm from clumping and makes them more motile. (Balch et al 1997, Murray et al 1998)
 - Vitamin C is essential for the maturation of the preovulatory follicle in women. (Werbach 1999)
- *Administer vitamin C with bioflavonoids, which promotes the uptake of vitamin C, protects it from oxidation and inhibits its conversion to its less active forms. (Bland 1995)

Vitamin E

- Vitamin E is the main antioxidant in several cell membranes, this includes playing an essential role in inhibiting free-radical damage to the unsaturated fatty acids of the sperm membrane. (Murray et al 1998)
- In vitro studies have shown that vitamin E increases the ability of sperm to fertilise eggs. (Murray et al 1998)
- One study showed that vitamin E reduces the level of lipid peroxide concentration in sperm pellet suspensions. The formation of lipid peroxides results in the destruction of the original lipid leading to the loss of integrity of the sperm membrane. Vitamin E thus enhances sperm health by inhibiting their formation. (Suleiman et al 1996)
- Vitamin E carries oxygen to the sex organs. (Balch et al 1997)

Zinc

- Zinc participates in every step of male reproduction – hormone metabolism, sperm formation, motility and count. (Cataldo et al 1995, Murray et al 1998)
- Zinc improves fertility by increasing sperm count and testosterone levels in men whose testosterone levels are low. In one study, zinc supplementation increased the sperm count of men with low testosterone levels from eight to 20 million/ml. (Murray et al 1998)
- Zinc supplementation reduces the risk of developing chromosomal abnormalities, thus improving fertility. (Naish et al 1996)
- Excessive copper antagonises zinc's reproductive functions, leading to infertility. Zinc prevents this by depressing copper levels in the body. (Naish et al 1996)

Selenium

- Selenium is an important antioxidant that protects the body against the harmful effects of chemical and heavy metal exposure and sensitivity.
- Selenium supplementation enhances sperm motility and reduces the risk of developing abnormal sperm in men. (NC 2003)
- In women, supplementation reduces the risks of infertility, spontaneous abortion and neural tube defects. (NC 2003)

Carnitine

- Carnitine is required for transporting fatty acids into the mitochondria. In turn, sperm derives most of their energy needs from fatty acids during their transport through the epididymis. (Murray et al 1998)
- After ejaculation, sperm motility is directly in proportion with carnitine content. The higher the carnitine content, the more mobile the sperm. When carnitine levels drop, sperm development, function and motility also decrease significantly. (Murray et al 1998)
- Carnitine also enhances the antioxidant actions of vitamin C and E. (Balch et al 1997)

*Folic Acid

- Folic acid is necessary to prevent neural tube defects. The neural tube closes within 28 days of conception, so it is vital that women of childbearing age, especially those who are trying to conceive, are supplemented with sufficient folic acid so as to avoid a deficiency in the first month of pregnancy. (Mahan et al 2000, NC 2003, Wardlaw 1999)

Infertility

Micronutrients	Therapeutic Dose for Adults (per day)	Cautions and Contraindications
Vitamin A	10000 – 50000 ius = 3300 – 16500 ug RE	<ul style="list-style-type: none"> - Excessive retinoids are toxic to a foetus. Daily exposures of 20000 – 25000 ius have been associated with foetal malformations. (Mahan et al 2000) - If pregnant: do not exceed 10000 ius per day. (Holford 1997, Mahan et al 2000)
Vitamin B ₁₂	800 – 3000 mcg	<ul style="list-style-type: none"> - No known toxicity. (Holford 1997)
Vitamin C (Ascorbic acid)	250 – 10000 mg	<ul style="list-style-type: none"> - Excessive doses may lead to bowel looseness. (Holford 1997) - May aggravate dyspepsia and gastric ulcers. (Clift 2003) - Use cautiously with anticoagulants. e.g. warfarin (Clift 2003)
Vitamin E	100 – 1000 mg	<ul style="list-style-type: none"> - Use cautiously with anticoagulants. e.g. warfarin (Clift 2003) - Use cautiously in hypertension and diabetes. (Clift 2003)
Zinc	10 – 100 mg	<ul style="list-style-type: none"> - Excessive doses may suppress immunity, cause vomiting, reduce HDL levels, increase cardiovascular disease, decrease iron and copper levels. (Balch et al 1997, Cataldo et al 1995, Holford 1997, Wardlaw 1999)
Selenium	25 – 100 mcg	<ul style="list-style-type: none"> - Excessive doses may interfere with protein structure and function in hair, nails and skin. (Holford 1997)
L-Carnitine	900 – 3000 mg	<ul style="list-style-type: none"> - Excessive doses may produce an unusual body odour. (WHMD) - Supplemental form is not advised for nursing mothers. (PDR Health)
Folic Acid	1000 – 5000 mcg	<ul style="list-style-type: none"> - 5 mg daily may mask a vitamin B₁₂ deficiency. (Groff et al 2000) - 1 – 10 mg daily may cause allergic reactions. (Wardlaw 1999) - 15 mg daily may cause insomnia and GIT distress. (Groff et al 2000)

Supplement: [Orthoplex B Vital](#)

Mental Health Disorders

Vitamin B₁

- Situated on a special site on nerve cell membranes, thiamine plays a part in the metabolism in neural tissue. For instance, thiamine triphosphate is thought to play a role in the production of energy for the nervous system. (Cataldo et al 1999, Groff 2000, Mahan et al 2000)
- Research has shown that thiamine potentiates and mimics the effects of acetylcholine, the important neurotransmitter involved in memory and Alzheimer's disease. Supplementation improves mental function in patients suffering from Alzheimer's disease and senility. (Murray et al 1998)

Vitamin B₅

- Pantothenic acid is a part of coenzyme A (CoA); CoA combines with two carbon acetate groups to form acetyl CoA. Acetyl CoA in turn joins with choline to form the neurotransmitter acetylcholine. (Clift 2003)
- Acetyl CoA contributes to the conversion of serotonin to melatonin, which helps to maintain mental health by helping to establish circadian rhythms. Depression as well as many sleep, neurological, cardiovascular and endocrine disorders, are associated with circadian rhythm dysfunctions. (Shils et al 1999)

Vitamin B₆

- Pyridoxal phosphate is a coenzyme required in the production of neurotransmitters like serotonin, dopamine, noradrenaline, adrenaline, GABA and histadine. The synthesis of these neurotransmitters are vital for preventing neurological disorders like depression, headaches, confusions and convulsions. (Groff 2000, Mahan et al 2000, Shils et al 1999, Wardlaw 1999)

Vitamin B₉ and vitamin B₁₂

- Folic acid, vitamin B12 and S-adenosyl-methionine (SAM) function as methyl donors to carry methyl molecules to neurotransmitters in the brain, which in turn allows them to function. SAM is the body's predominant methyl donor, and folic acid reduces depression by increasing the SAM content in the brain. (Murray et al 1998)
- Folic acid and vitamin B12 exhibit anti-depressive activity by stimulating the production of tetrahydrobiopterin, an essential factor in the synthesis of neurotransmitters like serotonin and dopamine. (Murray et al 1998)

Vitamin C and E

- Vitamin E prevents oxidative damage of the nerve cell membranes, and hence stabilises and maintains cellular integrity. Vitamin C regenerates vitamin E when it is oxidised. (Clift 2003)

Choline

- It joins with acetyl CoA to form acetylcholine, which transmits nervous impulses across synaptic junctions in nerves and is thus required to maintain proper nervous function of mood, behaviour, orientation, personality traits and judgement. It also helps to enhance memory. (Mahan et al 2000, Wardlaw 1999)
- Choline promotes the synthesis and release of acetylcholine, and it also increases the amount of acetylcholine stored in the brain. (Mahan et al 2000, Wardlaw 1999)
- Supplementation has been shown to improve the conditions of patients suffering from Alzheimer's disease, tardive dyskinesia, Huntington's disease, bipolar depression and manic depression. (Mahan et al 2000)

Zinc

- It is responsible for many aspects of mental health function, including DNA replication, repair and transcription in nerve cells, and for maintaining myelin sheath integrity. (Murray et al 1998)
- Zinc promotes optimal nerve function by chelating harmful heavy metals. It also reduces copper content in the body, which in excess, may cause severe brain damage and mental disorders like Wilson's disease. (Clift 2003)
- Zinc supplementation has been shown to improve memory, understanding, communication and social contact in patients suffering from Alzheimer's disease.

Sodium

- It is required for the generation and conduction of action potentials in neurons. These travel over long distances along a neuron and thus promotes the communication of nerves within the body. (Clift 2003)

Magnesium

- The accumulation of aluminium in the brain increases the risk of developing Alzheimer's disease. Aluminium absorption can be reduced by magnesium, as magnesium competes with aluminium for absorption in the blood-brain barrier. (Glick 1990)
- Magnesium, vitamin B6 and B3 act as cofactors in the conversion of tryptophan to serotonin, which promotes an improved sleep cycle. (Osiecki 1990)

Mental Health Disorders

Micronutrients	Therapeutic Dose for Adults (per day)	Cautions and Contraindications
Vitamin B ₁	5 – 100 mg	<ul style="list-style-type: none"> - Massive doses may suppress respiratory function and cause death. (Mahan et al 2000) - Very high doses may cause headaches, convulsions, muscular weakness, cardiac arrhythmia and allergies. (Groff et al 2000) - High doses may inhibit the use of other B vitamins. (Kirschmann et al 1996)
Vitamin B ₅	20 – 200 mg	<ul style="list-style-type: none"> - Massive doses may induce intestinal disturbance. (Groff et al 2000) - 100g daily may increase niacin excretion. (Groff et al 2000)
Vitamin B ₆	10 – 150 mg	<ul style="list-style-type: none"> - 500 mg daily may cause neurotoxicity. (Groff et al 2000) - Excessive doses may cause sensory neuropathy. (Groff et al 2000)
Vitamin B ₁₂	800 – 3000 mcg	<ul style="list-style-type: none"> - No known toxicity. (Holford 1997)
Folic Acid	1000 – 5000 mcg	<ul style="list-style-type: none"> - 5 mg daily may mask a vitamin B₁₂ deficiency. (Groff et al 2000) - 1 – 10 mg daily may cause allergic reactions. (Wardlaw 1999) - 15 mg daily may cause insomnia and GIT distress. (Groff et al 2000)
Choline	1 – 20 g	<ul style="list-style-type: none"> - Large doses may cause a fishy body odour, gastric distress, vomiting and diarrhoea. (Murray et al 1998, Wardlaw 1999)
Vitamin C (Ascorbic acid)	250 – 10000 mg	<ul style="list-style-type: none"> - Excessive doses may lead to bowel looseness. (Holford 1997) - May aggravate dyspepsia and gastric ulcers. (Clift 2003) - Use cautiously with anticoagulants. e.g. warfarin (Clift 2003)
Vitamin E	100 – 1000 mg	<ul style="list-style-type: none"> - Use cautiously with anticoagulants. e.g. warfarin (Clift 2003) - Use cautiously in hypertension and diabetes. (Clift 2003)
Magnesium	300 – 1000 mg	<ul style="list-style-type: none"> - None below 1000 mg. (Holford 1997) - With chronic use of magnesium containing drugs, hypermagnesaemia may occur in those with renal insufficiency. (Clift 2003)
Sodium	3 – 9 g	<ul style="list-style-type: none"> - Excessive intake may cause hypertension and fluid retention. This in turn increases the risk of cardiovascular disease, renal disease and oedema. (Clift 2003)
Zinc	10 – 100 mg	<ul style="list-style-type: none"> - Excessive doses may suppress immunity, cause vomiting, reduce HDL levels, increase cardiovascular disease, decrease iron and copper levels. (Balch et al 1997, Cataldo et al 1995, Holford 1997, Wardlaw 1999)

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