



# *Essential Nutrients for Hormones*



ESSENTIAL NUTRIENTS FOR HORMONES



# Essential Nutrients for Anxiety

**Folate:** Aids in production of neurotransmitters such as dopamine and serotonin, which have a calming effect on mood.

**Inositol:** A neurochemical messenger in the brain, inositol (vitamin B8) affects dopamine and serotonin receptors; Trials confirm it is very effective in reducing panic attacks.

**Choline:** Precursor to the neurotransmitter acetylcholine, which affects focus and mood; Low levels of choline linked to anxiety.

**Serine:** Exerts a calming effect by buffering the adrenal response to physical or emotional stress; Lowered anxiety scores of patients with post traumatic stress disorder.

**Copper:** Integral part of certain chemicals in the brain (such as endorphins) that calm anxious feelings; Anxiety-like behavior may be exacerbated with copper deficiency,

**Magnesium:** Regulates the HPA (hypothalamic-pituitary adrenal) axis which controls physical and psychological reactions to stress; Deficiency can induce anxiety and emotional hyper-reactivity.

**Selenium:** Repletion of selenium to normal levels reduced anxiety scores in clinical trials; Some suggest the mechanism of action is due to its role in key regulatory proteins (selenoproteins).

**Zinc:** Reduces anxiety in clinical trials, possibly due to its interaction with NMDA (N-methyl-D-aspartate) receptors in the brain which regulate mood.

**Vitamin B6:** Cofactor in synthesis of calming neurotransmitters such as GABA (gamma-aminobutyric acid), serotonin and dopamine.

**Vitamin B3:** One of the symptoms of severe B3 deficiency (pellagra) is anxiety; Pharmacological doses of B3 may enhance the calming effects of GABA in the brain; Converts tryptophan to serotonin.

**Vitamins D and E:** Low vitamin D status is linked to anxiety; Animal studies confirm the role of vitamins D and E in reducing anxiety-related behavior.

**Carnitine:** Studies show that carnitine can reduce anxiety and improve feelings of well being.

**Chromium:** Its effect on serotonin transmission may explain its anxiolytic (anxiety relieving) effect in animal studies.



# Essential Nutrients for Depression

**Chromium:** Elevates serotonin (feel-good neurotransmitter) levels in the brain; May be particularly effective on eating symptoms of depression such as carbohydrate craving and increased appetite, due to its effect on blood sugar regulation.

**Folate:** Building block for many “feel-good” neurotransmitters such as serotonin, dopamine and norepinephrine; Low folate causes poor response to antidepressant meds; The lower the folate, the more severe the depression

**Vitamin B12:** Depression may be a manifestation of B12 deficiency; repletion of B12 to adequate levels can improve treatment response; B12 deficiency common in psychiatric disorders.

**Vitamin B6:** Cofactor for serotonin and dopamine production (feel good chemicals); Studies indicate that low levels may predispose people to depression.

**Vitamin B2:** Low B2 has been implicated in depression due to its role in methylation reactions in the brain.

**Vitamin D:** Clinical trials suggest increasing blood levels of vitamin D, which is actually a hormone precursor, may improve symptoms of depression.

**Carnitine:** Increases serotonin and noradrenaline which lift mood; In trials, carnitine alleviates depression with few, if any, side effects.

**Inositol:** Influences signaling pathways in the brain; Particularly effective in SSRI (selective serotonin reuptake inhibitor) sensitive disorders.

**Biotin:** Part of the B-vitamin complex, biotin deficiency has induced depression in animal and human studies.

**Antioxidants:** Oxidative stress in the brain alters neurotransmitter function; Antioxidants protect our brain, which is very sensitive to oxidation; Several antioxidants – Vitamins A, C and E, Lipoic Acid, CoQ10, Glutathione and Cysteine – play a key role in prevention and treatment of depression.

**Serine:** Regulates brain chemistry; Involved in NMDA receptor function; Acts as a neurotransmitter; Low levels correlate with severity of depression.

**Zinc:** Improves efficacy of antidepressant drugs; Particularly useful for treatment resistant patients; Regulates neurotransmitters.

**Magnesium:** Deficiency damages NMDA (N-methyl-D-aspartate) receptors in the brain, which regulate mood; Well-documented anti-depressant effects.

**Selenium:** Integral part of regulatory proteins (selenoproteins) in the brain; Supplementation trials are promising; May alleviate postpartum depression.



# Essential Nutrients for Estrogen

**Choline** Estrogen stimulates the breakdown of phosphatidylcholine (cell membrane) so those with low estrogen (postmenopausal women) require more choline; Detoxes excess estrogen via methylation pathway.

**Folate** Deficiency reduces estrogen levels; Excess folate is linked to some types of estrogen-related breast cancer; Detoxes excess estrogen via methylation pathway; Regulates estrogen's effect on genes.

**Vitamin B6** Protects genes from estrogen-induced damage thus lowering risk of hormone related cancers; Detoxes excess estrogen via methylation pathway; Estrogen-based oral contraceptives cause B6 deficiency.

**Vitamin D** Regulates synthesis of estradiol and estrone; Enhances estrogen's protective effect on bones.

**Vitamin C** Increases the most potent estrogen (estradiol) in women on hormone therapy; Lowers aromatase (enzyme that converts testosterone to estrogen) in ovaries.

**Vitamin K** Inhibits estrogen activity by binding to estrogen receptors; Lowers the ratio of estradiol (strong estrogen) to estrone (weaker estrogen).

**Vitamin E** Deficiency impairs estrogen detoxification pathway; Some forms of vitamin E inhibit estrogen action, especially in breast tissue; Low levels linked to higher estrogen.

**Vitamin A** Helps metabolize the biologically active estrogen (estradiol) to an inactive form (estrone).

**Calcium** Calcium-D-glucarate lowers estradiol levels; Helps breakdown estrogen in the liver and convert it to a less toxic form.

**Selenium** Estrogen levels affect how selenium is distributed to various tissues in the body.

**Magnesium** Cofactor for the enzyme that removes toxic forms of estrogen (catechol-Omethyltransferase); Estrogen alters magnesium levels throughout menstrual cycle.

**Zinc** Estrogen lowers risk of zinc deficiency; Zinc dependent proteins metabolize estrogen.

**Cysteine** Prevents oxidation of estrogen into a dangerous form that causes breast cancer.



# Essential Nutrients for Fatigue

**Chromium** Promotes glucose uptake into cells, helping stabilize blood sugar.

**Zinc** deficiency lowers immunity and may cause muscle fatigue; Involved in several reactions for energy metabolism.

**Asparagine** Supplementation of this amino acid delayed fatigue during exercise by decreasing the rate at which glycogen was used up; needed for gluconeogenesis, a process that allows glucose to be made from protein to prevent blood sugar from getting too low.

**Biotin** Helps liver utilize glycogen for energy. Animal studies confirm that biotin deficiency causes clinical fatigue.

**Glutamine** Mental and physical fatigue coincides with reduced levels of this amino acid in various tissues. Supplementation makes muscle more sensitive to insulin, increasing energy levels.

**Serine** Counteracts the overproduction of fatigue-causing stress hormones.

**CoQ10** Deficiency causes fatigue due to its role in mitochondrial energy metabolism; therapeutic benefits particularly noticeable in chronic fatigue syndrome.

**Fructose Intolerance Fatigue** (and hypoglycemia) are classic symptoms of this condition, since it depletes the main form of cellular energy, ATP.

**Magnesium** Required to store energy molecule ATP; Repletion of magnesium in chronic fatigue patients shows clinical improvement in energy levels.

**Antioxidants** Several studies confirm that oxidative stress exacerbates clinical symptoms of fatigue. Mitochondrial dysfunction (inefficient energy metabolism) can be treated therapeutically with antioxidants such as Selenium, Cysteine, α-Lipoic acid and Glutathione, of which unusually low levels are seen in chronic fatigue patients.

**Vitamin C** Assists iron uptake and transport; Precursor to carnitine and several hormones that affect energy levels. Supplementation reduced fatigue in various trials.

**Vitamin A** When cellular levels of vitamin A are low, mitochondrial respiration and ATP production decreases.

**Vitamin E** Inverse correlation exists between fatigue and vitamin E levels.

**Vitamin D** Low levels are seen in patients with chronic fatigue syndrome; deficiency causes reduced muscle strength.

**B Vitamins** Necessary for converting food into energy; Cofactors in the mitochondrial respiratory chain include B1, B2, B3, B5, B6, B12 and Folate.

**Carnitine** Transports fatty acids into mitochondria; Decreases both mental and physical fatigue in clinical trials.



# Essential Nutrients for Female Fertility

**Vitamin B6 & B12** Both are needed to convert toxic homocysteine to a benign form; Low homocysteine levels linked to a better chance of pregnancy.

**Vitamin C** Increases serum progesterone levels; Induces ovulation in some women; Enhances effect of the fertility drug clomiphene.

**Vitamin D** Higher levels linked to better success rates of IVF (in vitro fertilization); Influences production of the sex hormones estradiol and progesterone.

**Vitamin E** Protects reproductive cells (follicles); May improve endometrial response (ability of fertilized egg to implant into uterine wall properly) during IVF.

**Selenium** Deficiency implicated in miscarriage and infertility; In one trial, 100% of infertile women achieved pregnancy after supplementation.

**Glutathione** Protects eggs (fertilized or not) from damage by reactive oxygen species; Protective action of follicle stimulating hormone on embryonic development is due largely to glutathione synthesis.

**Cysteine** N-acetyl cysteine can improve ovulation and pregnancy rates in women with infertility due to PCOS (polycystic ovary syndrome) that do not respond to fertility drugs; improves viability of endometrial cells in vitro; Precursor to glutathione.

**Antioxidant Status** Reproductive cells, including embryos, are very susceptible to damage from oxidative stress due to the rapid rate of growth; Low antioxidant status can cause infertility or miscarriage.

**Minerals** Several enzymes needed to protect a woman's reproductive organs (such as superoxide dismutase) are dependent on the trace elements zinc, copper and magnesium.

**Folate** Protects genes during rapid cell division which increases likelihood of a healthy embryo (via methylation of DNA); Deficiency raises homocysteine which damages reproductive cells.



# Essential Nutrients for Gastrointestinal Health

**Glutamine** Preferred fuel for enterocytes (small intestine cells), which use the most glutamine in the entire body; Keeps the junctions between intestinal epithelial cells tight so foreign proteins cannot enter bloodstream.

**Zinc** Decreases intestinal permeability; Maintains integrity of intestinal wall, especially when inflammatory chemicals (TNF $\alpha$ ) compromise epithelial lining; Works with vitamin A in regenerating cells that line the gut.

**Vitamin A** Regulates growth of epithelial cells, including those that line the gastrointestinal (GI) tract; Reduces inflammatory proteins in the gut.

**Vitamin C** An inflamed gut uses up the antioxidant vitamin C faster than a healthy gut; Promotes tissue healing in GI tract; Reduces gastrointestinal inflammation.

**Vitamin D** Keeps gut flora healthy by protecting good bacteria; Activates adaptive immunity that originates in GI tract; Promotes gut barrier integrity; Deficiency linked to inflammatory bowel disease flare-ups.

**Vitamin K** Synthesized by intestinal bacteria; Deficiency common in chronic GI disorders; Bone demineralization that occurs with inflammatory bowel diseases (Crohn's, etc) is caused by vitamin K deficiency since it is a required cofactor for bone formation.

**Vitamin B12** Improves gastrointestinal complaints in some patients with dyspepsia (indigestion); Antacids deplete B12.

**Carnitine** May be therapeutically beneficial in people with colitis (inflammation of colon) due to its role in fatty acid metabolism, which is often impaired in GI disorders.

**Vitamin B6** Deficiency is strongly linked with a higher risk of developing colon cancer.

**Folate** Deficiency alters genes in a way that makes colon cells more likely to become cancerous.

**Choline** Maintains the barrier function of gastric epithelium (helps prevent stomach ulcers) via its role in building cell membranes and acting as a surfactant in the GI tract.

**Magnesium** Deficiency affects the amount of good bacteria found in the gut; May help prevent stomach ulcers; Insufficient levels are very common in people with irritable bowel; Antacids induce magnesium deficiency.

**Lipoic Acid** Suppresses damaging chemicals (cytokines) in GI tract that cause an inflammatory immune response; Preserves glutathione levels and recycles vitamin C.

**Glutathione** Counteracts oxidative stress in the intestinal mucosa (gut wall); Recycles antioxidants such as vitamins C & E.

**Selenium** Cofactor to glutathione peroxidase (GPx), which protects intestinal wall from inflammatory damage; Lower GPx activity due to selenium deficiency is very common in people with gut inflammation.



# Essential Nutrients for Headaches

**Carnitine** Implicated in migraine pathophysiology due to its role in mitochondrial energy metabolism.

**Lipoic Acid** Enhances mitochondrial energy metabolism.

**Vitamin C** Newly discovered role in neural tissue may explain its clinical headache frequency.

**Vitamin B12** Scavenges nitric oxide, which is implicated in migraine pathogenesis.

**Folate** MTHFR gene linked to migraines. This gene raises folate requirements.

**Glutathione** Low levels of glutathione peroxidase implicated in migraine etiology.

**Magnesium** Efficacious for migraine prevention in several trials; magnesium deficiency can cause arterial spasm and its role in neurotransmission may explain the migraine-magnesium depletion link.

**Vitamin D & Calcium** Small trials show benefit with combined supplementation.

**Vitamin B2** Effective for migraine prevention, aids mitochondrial energy metabolism.

**CoQ10** Aids mitochondrial metabolism; may prevent migraines.

**Vitamin B3** Dilates blood vessels; Increases serotonin.



# Essential Nutrients for Hypothyroidism

**B Vitamins** A deficiency in B6, B12, or B9 (folate) can cause elevated homocysteine, which is linked with hypothyroidism. Folic acid levels have been linked to levels of thyroid stimulating hormone (TSH).

**Vitamin C and E** Partially restores thyroid function when liver detoxification ability is compromised.

**Vitamin A** Activates gene that regulates TSH (thyroid stimulating hormone).

**Zinc** Increases thyroid hormone T3 in deficient subjects.

**Copper** Low levels seen in experimentally induced hypothyroidism; Indirectly affects thyroid status by its antioxidant role via superoxide dismutase.

**Selenium** Converts thyroid hormones T4 (thyroxine) into T3 (triiodothyronine); deficiency reduces T3 levels causing classic hypothyroidism symptoms such as fatigue, depression and/or weight gain.

**Asparagine** This amino acid is part of the structure of thyroid stimulating hormone which regulates communication with other hormones.

**Carnitine** Decreased tissue levels of carnitine in both hypo- and hyperthyroidism contribute to muscle fatigue.

**Lipoic Acid** Improves endothelial function in people with subclinical hypothyroidism; Protects thyroid cells from oxidative stress; May interfere with T4 therapy.

**Choline** Hypothyroidism negatively affects choline function in the brain, which can affect mood and cognition.

**Glutathione** Hypothyroidism decreases efficacy of some antioxidants, such as glutathione peroxidase and superoxide dismutase.



# Essential Nutrients for Insomnia

**Vitamin B3 (Niacin)** Increases REM sleep; Improves both quality and quantity of sleep by converting tryptophan to serotonin.

**Folate & Vitamin B6** Both are cofactors for several neurotransmitters in the brain such as serotonin and dopamine, many of which regulate sleep patterns.

**Vitamin B12** Normalizes circadian rhythms (sleep-wake cycles); Therapeutic benefits of B12 supplementation, both oral and intravenous, seen in studies.

**Magnesium** Improving magnesium status is associated with better quality sleep; Mimics the action of melatonin; Also alleviates insomnia due to restless leg syndrome.

**Zinc & Copper** Both interact with NMDA (N-methyl-D-aspartate) receptors in the brain that regulate sleep; A higher Zn/Cu ratio is linked to longer sleep duration.

**Oleic Acid** This fatty acid is a precursor of oleamide, which regulates our drive for sleep and tends to accumulate in the spinal fluid of sleep-deprived animals. Oleic acid also facilitates the absorption of vitamin A.

**Vitamin A** Studies suggest Vitamin A deficiency alters brain waves in nonREM sleep causing sleep to be less restorative.

**Vitamin B1 (Thiamin)** In clinical trials, supplementation of healthy individuals that had marginal B1 deficiency improved their sleep.



# Essential Nutrients for Male Fertility

**Carnitine** Transports fatty acids, the preferred energy source of sperm, into cells; Significantly improves sperm motility in clinical trials.

**Vitamin A** Regulates genes that control sperm production (spermatogenesis); Deficiency may lower sperm count.

**Vitamin D** Increases sperm motility; Induces acrosome reaction, a process where a sperm releases enzymes to allow fusion with an egg; Men with low vitamin D may have slower sperm.

**Vitamin C** Low levels increase damage to sperm's genetic material; Supplementation improved sperm count, motility and structure in human trials.

**Vitamin E** Protects sensitive sperm cell membranes; Enhances sperm's ability to penetrate an egg.

**Vitamin B12** Needed for cellular replication, including spermatogenesis; B12 moves from blood to semen to assist in sperm production; May increase sperm count.

**Folate** Deficiency may reduce testosterone; Critical to sperm creation due to its role as a methyl donor in DNA synthesis; The MTHFR (methylenetetrahydrofolate reductase) C677T gene, which increases folate requirements, is a risk factor for male infertility.

**Antioxidant Status** Sperm are highly susceptible to free radical damage to both their genetic material and cell membrane; Poor antioxidant status is a well documented cause of male infertility.

**Copper & Manganese** Both are cofactors for superoxide dismutase (a very powerful antioxidant) that protects sperm from oxidative damage.

**Coenzyme Q10** Acts as a potent antioxidant protecting sperm from damage; Improves semen bioenergetics via its role in mitochondrial function (helps sperm remain viable); A direct correlation exists between CoQ10 and sperm count & motility.

**Selenium** Required for sperm maturation; Protects lipid shell encasing each sperm (prevents lipid peroxidation), which is especially important since sperm have a very delicate fatty acid composition.

**Zinc** Supplementation in men with low zinc status is often successful for male infertility; Deficiency lowers testosterone & reduces sperm count.

**Glutathione** Cofactor to the enzyme (glutathione peroxidase) that ensures structural integrity of sperm; Deficiency compromises sperm motility.



# Essential Nutrients for Testosterone

**Folate** Deficiency reduces circulating testosterone; Evidence suggests testosterone may regulate folate metabolism.

**Vitamin B6** Regulates sex hormones; Vitamin B6 reduces prolactin which stimulates hypothalamus to increase testosterone; B6 also a cofactor for dopamine synthesis which influences testosterone levels.

**Vitamin D** Actually a hormone, vitamin D regulates the synthesis of testosterone; Supplementation can significantly increase total, free and bioactive testosterone levels.

**Vitamin K** Deficiency reduces testosterone production because the rate-limiting enzyme for testosterone synthesis (Cyp11a) is vitamin K dependent.

**Vitamin E** Long term administration of some forms of vitamin E may reduce testosterone levels.

**Vitamin C** Studies suggest it protects prostate from testosterone induced tumors.

**Carnitine** Boosts dopamine, which is directly related to testosterone levels; May prevent testosterone decline after intense physical stress.

**Magnesium** Makes testosterone more biologically active in the body; Raises free and total testosterone levels in men.

**Zinc** Deficiency lowers testosterone levels; Inhibits prolactin secretion (testosterone inhibiting hormone); Supplementation increases testosterone depending on baseline levels.



# Essential Nutrients for Weight Management

**Biotin** Boosts metabolism by improving glycemic control (stabilizes blood sugar) and lowering insulin, a hormone that promotes fat formation.

**Carnitine** Carries fatty acids into the cell so they can be burned for fuel; Helps reduce visceral adiposity (belly fat).

**Calcium** Inhibits the formation of fat cells; Also helps oxidize (burn) fat cells.

**Lipoic Acid** Improves glucose uptake into cells, which helps a person burn fat more efficiently.

**Chromium** Makes the body more sensitive to insulin, helping to reduce body fat and increase lean muscle.

**Vitamin B5** Taking B5 lowers body weight by activating lipoprotein lipase, an enzyme that burns fat cells. One study linked B5 supplementation to less hunger when dieting.

**Magnesium** Low magnesium in cells impairs a person's ability to use glucose for fuel, instead storing it as fat; Correcting a magnesium deficiency stimulates metabolism by increasing insulin sensitivity. Magnesium may also inhibit fat absorption.

**Glutamine** Reduces fat mass by improving glucose uptake into muscle.

**Cysteine** Supplementation with this antioxidant reduced body fat in obese patients.

**Inositol** Supplementation may increase adiponectin levels.

**Vitamin B3 (Niacin)** Treatment with B3 increases adiponectin, a weight-loss hormone secreted by fat cells; Niacin-bound chromium supplements helped reduced body weight in clinical trials.

**Vitamin A** Enhances expression of genes that reduce a person's tendency to store food as fat; Reduces the size of fat cells.

**Vitamin E** Inhibits pre-fat cells from changing into mature fat cells, thus reducing body fat.

**Vitamin D** Deficiency strongly linked to poor metabolism of carbohydrates; Genes that are regulated by vitamin D may alter the way fat cells form in some people.

**Vitamin K** Poor vitamin K status linked to excess fat tissue; Vitamin K helps metabolize sugars.

**Zinc** Deficiency of zinc reduces leptin, a beneficial hormone that regulates appetite, which is reversed by zinc repletion.

**Asparagine** This amino acid increases insulin sensitivity which helps the body store energy in muscle instead of storing it as body fat.