Nutrient Correlation Wheels

Deficiencies Correlated with Disease Conditions

ADHD

Folate
Low folate status in pregnancy linked to hyperactivity in children; People with the MTHFR(methyl tetrahydrafolate reductase) gene are predisposed to folate deficiency and more likely to have ADHD. [1,2]

Antioxidant Status
Oxidative imbalance is prevalent in ADHD patients and likely plays a causative role; Deficiency of glutathione common in ADHD.[3,4,5,6]

Vitamin B6
Evidence suggests high dose supplementation of B6 is as effective as Ritalin for ADHD, probably due to its role in raising serotonin levels. [7,8,9]

Magnesium
Deficiency linked to poor function of the neurotransmitters that control emotion, social reactions, hyperactivity and attention; Synergistic effect with Vitamin B6.[8.9.10]

Choline
Precursor to neurotransmitter acetylcholine, which regulates memory focus and muscle control (hyperactivity).[24,25,26]

Zinc
Cofactor for dopamine synthesis which affects mood and concentration in ADHD; Low zinc depresses both melatonin and serotonin production which affect information processing and behavior in ADHD. [11,12,13,14]

Glutamine
Precursor for the calming neurotransmitter GABA (gamma-aminobutyric acid) that affects mood, focus and hyperactivity; Disruption of the glutamine-containing neurotransmission systems may cause ADHD. [21,22,23]

Serine
Administration of phosphatidylserine with omega 3 fatty acids improved ADHD symptoms (attention scores) significantly better than omega 3 fatty acids alone, suggesting a synergistic effect; Phosphatidylserine increases dopamine levels.[18,19,20]

Carnitine
Reduces hyperactivity and improves social behavior in people with ADHD due to its role in fatty acid metabolism; Some consider it a safe alternative to stimulant drugs.[15,16.17]

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ANXIETY

Chromium
Its effect on serotonin transmission may explain its anxiolytic (anxiety relieving) effect in animal studies.[30,31]

Folate
Aids in production of neurotransmitters such as dopamine and serotonin, which have a calming effect on mood.[19,32,33]

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.[1,2]

Carnitine
Studies show that carnitine can reduce anxiety and improve feelings of well being.[28,29]

Choline
Precursor to the neurotransmitter acetylcholine, which affects focus and mood; Low levels of choline linked to anxiety.[3,4]

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.[24,25,26,27]

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.[5,6,7]

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.[19,22,23]

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.[8,9,10]

Vitamin B6
Cofactor in synthesis of calming neurotransmitters such as GABA (gamma-aminobutyric acid), serotonin and dopamine.[19,20,21]

Zinc
Reduces anxiety in clinical trials, possibly due to its interaction with NMDA (N-methyl-D- aspartate) receptors in the brain which regulate mood.[16,17,18]

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).[14,15]

Magnesium
Regulates the HPA (hypothalamic-pituitary adrenal) axis which controls physical and psychological reactions to stress; Deficiency can induce anxiety and emotional hyper-reactivity.[11,12,13]

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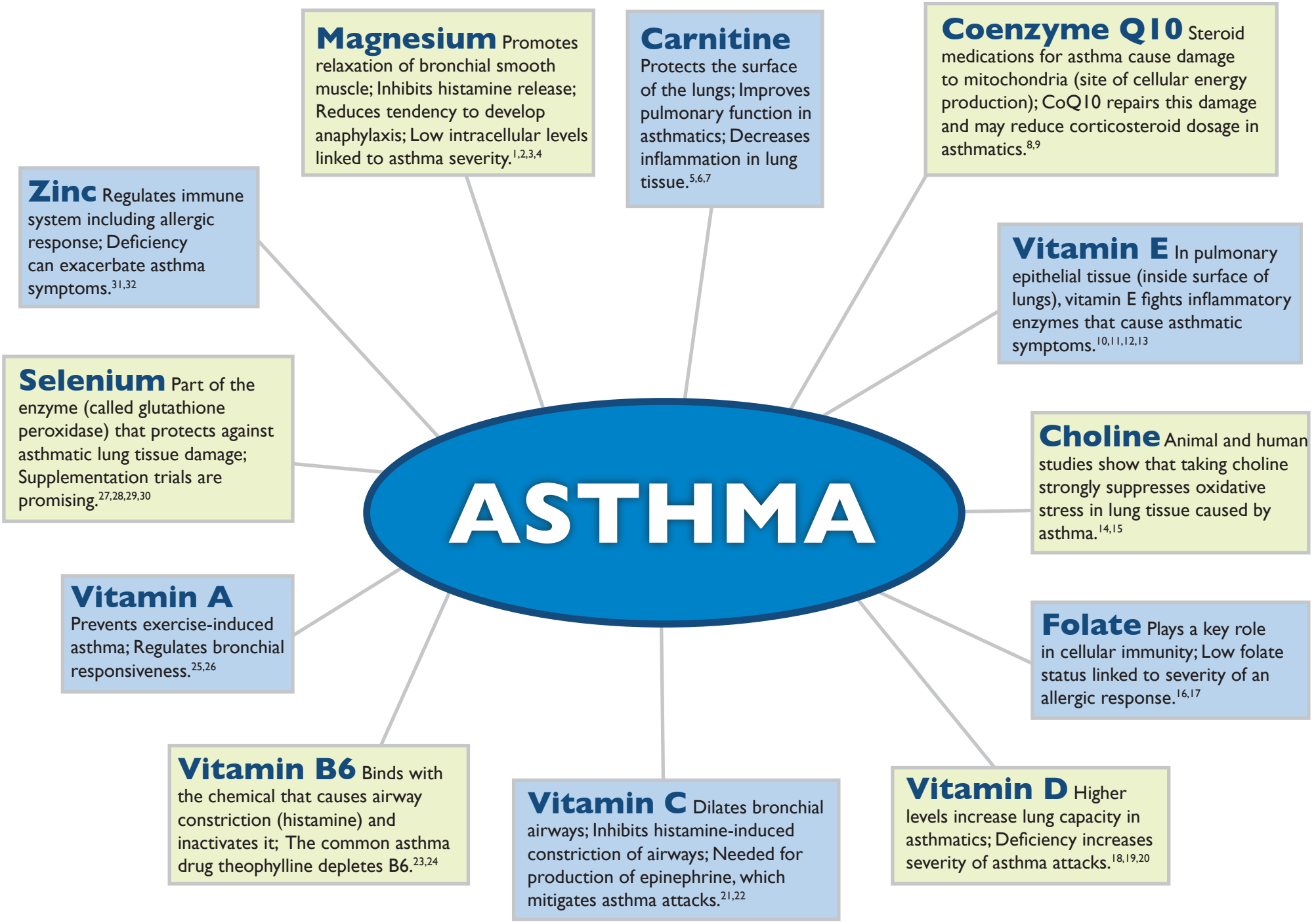

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AUTISM

Vitamin A
One cause of autism may be a defect in a retinoid receptor protein (G-alpha protein) which is critical for language processing, attention and sensory perception; Evidence suggests natural vitamin A fixes this protein defect in autistics.[1,2]

Vitamin D
High dose vitamin D therapy reversed autistic behaviors in severely deficient children; Maternal vitamin D deficiency may predispose children to autism.[3,4,5]

Carnitine
Transports fatty acids into cells; Low carnitine (common in autism) impairs the ability to use fatty acids for learning and social development.[6,7]

Zinc
Eliminates toxic mercury from brain tissue; Zinc/ copper ratio is particularly low in autistic kids; Low zinc impairs the protein (called metallothionein) that removes heavy metals from the body.[8,9,10]

Magnesium
Cofactor for the neurotransmitters that affect social reactions and emotion; Autistics have low levels; Improves effectiveness of B6 therapy.[11,12,13]

Folate
Oral folate therapy can resolve symptoms of autism in some cases, particularly in autistics with genes that impair folate dependent enzymes.[31,32,33]

Vitamin B6
Cofactor the neurotransmitters serotonin and dopamine; Conversion of B6 to its active form is compromised in many autistics; Supplementation trials with B6 resulted in better eye contact, speech and fewer self-stimulatory behavior in autistics; Some consider B6 in combination with magnesium to be a breakthrough treatment for autism.[14,15]

Glutamine
Blood levels of this amino acid which acts as a neurotransmitter are particularly low in autistics. Glutamine also helps prevent leaky gut syndrome, which can exacerbate autistic symptoms.[28,29,30]

Vitamin B12
Low B12 impairs methylation (detoxification) which causes the neurological damage responsible for many autistic symptoms; Deficiency of B12 can cause optic neuropathy and vision loss in autistics; B12 raises cysteine and glutathione levels.[16,17,18]

Vitamin C
Improved symptom severity and sensory motor scores in autistic patients possibly due to interaction with dopamine synthesis; Vitamin C also has a strong sparing effect on glutathione.[26,27]

Vitamin B1
Deficiency linked to delayed language development; Supplementation may benefit autistic patients.[19,20]

Glutathione & Cysteine
Commonly deficient in autistic patients, lack of these antioxidants impair detoxification and methylation processes; Low levels linked to neurological symptoms in autism which is often considered an oxidative stress disorder.[21,22,23,24,25]

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DEPRESSION

Selenium
Integral part of regulatory proteins (selenoproteins) in the brain; Supplementation trials are promising; May alleviate postpartum depression.[5,6]

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.[37,38,39]

Folate
Building block for many "feel-good" neurotransmitters such as serotonin, dopamine and norepinephrine; Low folate causes poor response to anti-depressant meds; The lower the folate, the more severe the depression.[7,8,9,10]

Magnesium
Deficiency damages NMDA (N-methyl-D-aspartate) receptors in the brain, which regulate mood; Well-documented anti-depressant effects.[1,2,3,4]

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.[11,12,13]

Zinc
Improves efficacy of antidepressant drugs; Particularly useful for treatment resistant patients; Regulates neurotransmitters.[33,34,35,36]

Vitamin B6
Cofactor for serotonin and dopamine production (feel good chemicals); Studies indicate that low levels may predispose people to depression.[14,15,16]

Serine
Regulates brain chemistry; Involved in NMDA receptor function; Acts as a neurotransmitter; Low levels correlate with severity of depression.[31,32]

Vitamin B2
Low B2 has been implicated in depression due to its role in methylation reactions in the brain.[17,18]

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.[28,29,30]

Vitamin D
Clinical trials suggest increasing blood levels of vitamin D, which is actually a hormone precursor, may improve symptoms of depression.[19,20,21]

Inositol
Influences signaling pathways in the brain; Particularly effective in SSRI (selective serotonin reuptake inhibitor) sensitive disorders.[24,25]

Carnitine
Increases serotonin and noradrenaline which lift mood; In trials, carnitine alleviates depression with few, if any, side effects.[22,23]

Biotin
Part of the B-vitamin complex, biotin deficiency has induced depression in animal and human studies.[26,27]

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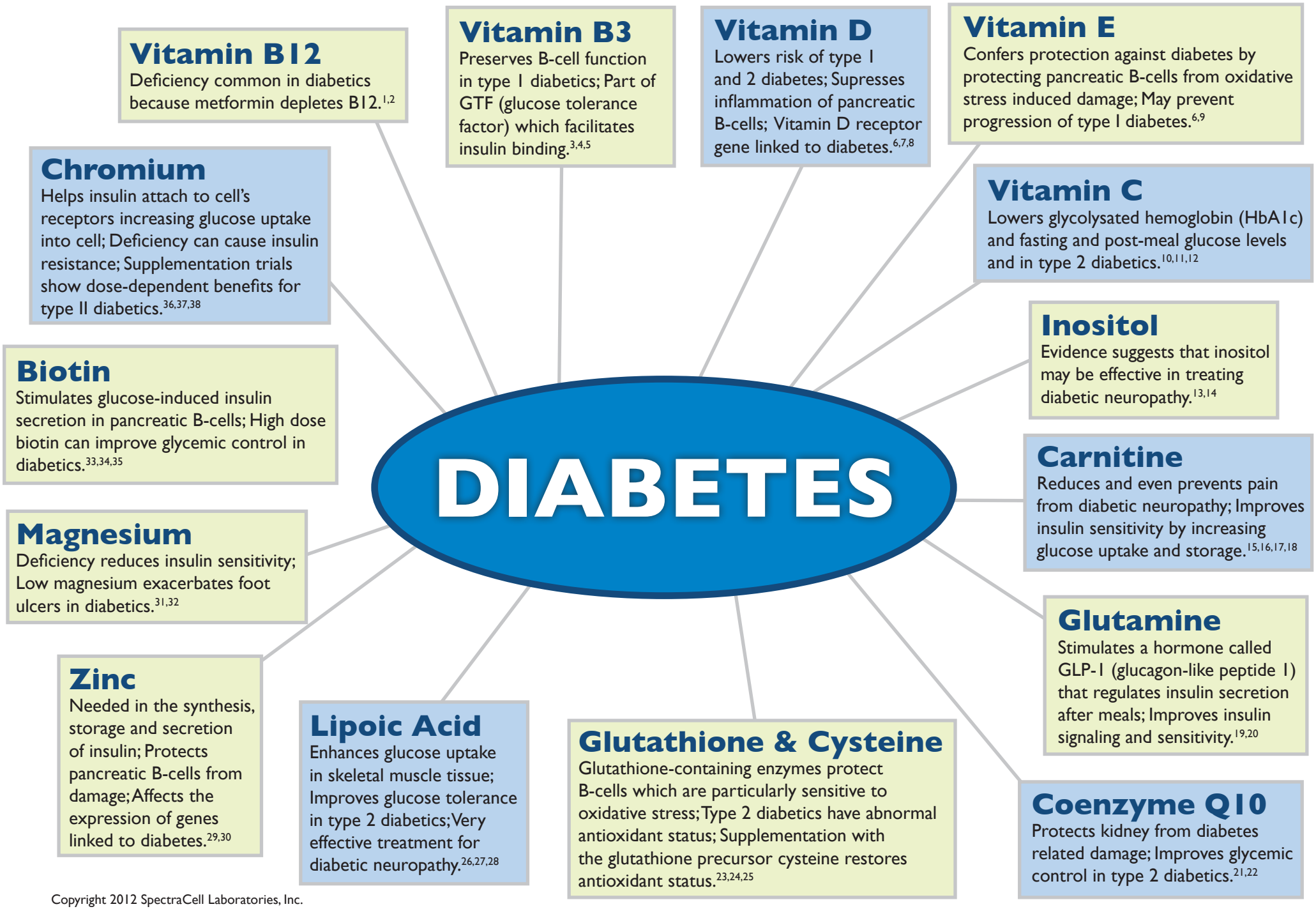

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DYSLIPIDEMIA

Manganese
Cofactor to an antioxidant (superoxide dismutase) that repairs damage to blood vessels caused by oxidized LDL (low density lipoprotein). [1,2]

Magnesium
Deficiency causes pro-atherogenic (heart-disease causing) changes in lipoprotein metabolism; Protects LDL (low density lipoprotein) from being oxidized. [3,4]

Vitamin C
Protects LDL from oxidation, thus making it less "sticky" and prone to atherosclerosis (clogging of arteries); Prevents white blood cells (monocytes) and oxidized LDL from sticking to blood vessel wall; Lowers Lp(a) in some people. [5,6,7]

Vitamin D
Suppresses foam cell formation thus reducing risk of lipid-related arterial blockages; Deficiency linked to dyslipidemia. [8,9]

Zinc
Suboptimal zinc raises dangerous lipoproteins that promote vascular inflammation and arterial plaque formation; Cellular zinc controls the gene that makes heart-protective HDL (high density lipoprotein). [34,35,36]

Vitamin B3
Niacin (B3) effectively lowers the highly atherogenic Lp(a) by decreasing its rate of synthesis in the liver. [10,11]

Selenium
Prevents post-prandial (after a meal) changes in lipoproteins that make them susceptible to oxidation and thus harmful. [32,33]

Vitamin B5
Favorably alters low density lipoprotein metabolism and reduces triglycerides; Full benefit of lipid lowering effects may not be seen for up to four months. [12,13]

Copper
Several copper-dependent enzymes affect lipoprotein metabolism; Deficiency contributes to fatty buildup in arteries caused by dyslipidemia. [29,30,31]

Carnitine
In supplementation trials, carnitine lowers triglycerides, oxidized LDL and the atherogenic Lp(a); This effect is likely due to its role in transporting fatty acids into cells so they can be used as fuel. [14,15,16]

Coenzyme Q10
It is well established that statins, often prescribed for dyslipidemia, deplete CoQ10; Lowers Lp(a) and improves efficacy of some dyslipidemia meds. [27,28]

Chromium
Specifically improves the dyslipidemia that accompanies insulin resistance; May increase HDL; Synergistic effect with niacin (B3) for dyslipidemia. [24,25,26]

Choline
Regulates HDL metabolism; Part of the enzyme lecithin-cholesterol acyltransferase that has a major impact on lipoprotein metabolism. [22,23]

Inositol
Decreases small, dense LDL especially in patients with metabolic syndrome; Lowers triglycerides. [19,20,21]

Lipoic Acid
Improves lipid profile by reducing small, dense LDL (dangerous type); Protects vascular lining from oxidized cholesterol. [17,18]

Additional nutrients affect lipid metabolism. This list is non-exhaustive.

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Estrogen

Cysteine
Prevents oxidation of estrogen into a dangerous form that causes breast cancer. [29,30,31]

Choline
Estrogen stimulates the breakdown of phosphatidylcholine (cell membrane) so those with low estrogen (postmenopausal women) require more choline; Detoxifies excess estrogen via methylation pathway.[1,32,33]

Folate
Deficiency reduces estrogen levels; Excess folate is linked to some types of estrogen-related breast cancer; Detoxifies excess estrogen via methylation pathway; Regulates estrogen's effect on genes.[1,2,3]

Zinc
Estrogen lowers risk of zinc deficiency; Zinc dependent proteins metabolize estrogen. [26,27,28]

Vitamin B6
Protects genes from estrogen-induced damage thus lowering risk of hormone related cancers; Detoxifies excess estrogen via methylation pathway; Estrogen-based oral contraceptives cause B6 deficiency.[4,5,6,7]

Magnesium
Cofactor for the enzyme that removes toxic forms of estrogen (catechol-O-methyltransferase); Estrogen alters magnesium levels throughout menstrual cycle. [1,24,25,26]

Vitamin D
Regulates synthesis of estradiol and estrone; Enhances estrogen's protective effect on bones. [8,9,10]

Selenium
Estrogen levels affect how selenium is distributed to various tissues in the body. [22,23]

Vitamin C
Increases the most potent estrogen (estradiol) in women on hormone therapy; Lowers aromatase (enzyme that converts testosterone to estrogen) in ovaries. [11,12,13]

Calcium
Calcium-D-glucarate lowers estradiol levels; Helps breakdown estrogen in the liver and convert it to a less toxic form. [1,20,21]

Vitamin K
Inhibits estrogen activity by binding to estrogen receptors; Lowers the ratio of estradiol (strong estrogen) to estrone (weaker estrogen). [14,15]

Vitamin A
Helps metabolize the biologically active estrogen (estradiol) to an inactive form (estrone). [18,19]

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. [1,16,17]

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FATIGUE

Carnitine Transports fatty acids into mitochondria; Decreases both mental and physical fatigue in clinical trials.[15,31,32]

Chromium Promotes glucose uptake into cells, helping stabilize blood sugar.[16,33]

Zinc Deficiency lowers immunity and may cause muscle fatigue; Involved in several reactions for energy metabolism.[15,34,35]

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.[1,2,3]

B Vitamins Necessary for converting food into energy; Cofactors in the mitochondrial respiratory chain include B1, B2, B3, B5, B6, B12 and Folate.[8,15,16,26-30]

Biotin Helps liver utilize glycogen for energy. Animal studies confirm that biotin deficiency causes clinical fatigue.[4]

Vitamin D Low levels are seen in patients with chronic fatigue syndrome; Deficiency causes reduced muscle strength.[24,25]

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.[5,6,7]

Vitamin E Inverse correlation exists between fatigue and vitamin E levels.[23]

Serine Counteracts the overproduction of fatigue-causing stress hormones.[8,9]

Vitamin A When cellular levels of vitamin A are low, mitochondrial respiration and ATP production decreases.[22]

CoQ10 Deficiency causes fatigue due to its role in mitochondrial energy metabolism; therapeutic benefits particularly noticeable in chronic fatigue syndrome.[10,11,12,15]

Vitamin C Assists iron uptake and transport; Precursor to carnitine and several hormones that affect energy levels. Supplementation reduced fatigue in various trials.[15,16,21]

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, a-Lipoic acid and Glutathione, of which unusually low levels are seen in chronic fatigue patients.[12,16,18,19,20]

Magnesium Required to store energy molecule ATP; Repletion of magnesium in chronic fatigue patients shows clinical improvement in energy levels.[15,16,17]

Fructose Intolerance Fatigue (and hypoglycemia) are classic symptoms of this condition, since it depletes the main form of cellular energy, ATP.[13,14]

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Female Infertility

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.[1,2,3,4]

Vitamin B_6 & B_{12}

Both are neededto convert toxic homocysteine to a benign form; Low homocysteine levels linked to a better chance of pregnancy.[5,6,7,8]

Vitamin C

Increases serum progesterone levels; Induces ovulation in some women; Enhances effect of the fertility drug clomiphene.[9,10,11,12]

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**.[22,30,31,32]

Vitamin D

Higher levels linked to better success rates of IVF (in vitro fertilization); Influences production of the sex hormones estradiol and progesterone.[13,14,15]

Vitamin E

Protects reproductive cells (follicles); May improve endometrial response (ability of fertilized egg to implant into uterine wall propersly) during IVF.[16,17,18,19]

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.[19,22,28,29]

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; Precurso to glutathione .[25,26,27]

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.[22,23,24]

Selenium

Deficiency implicated in miscarriage and infertility; In one trial, 100% of infertile women achieved pregnancy after supplementation.[20,21]

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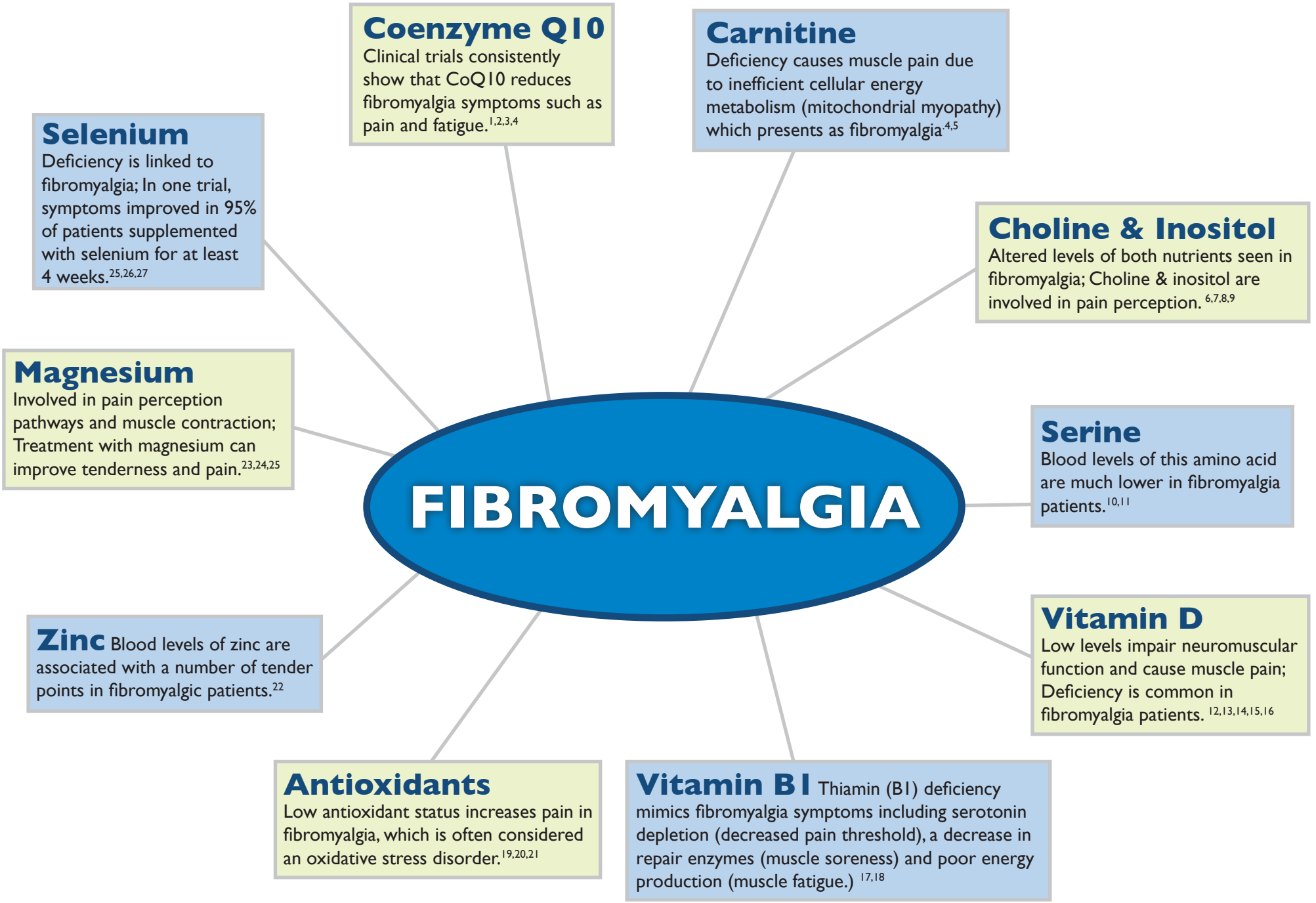

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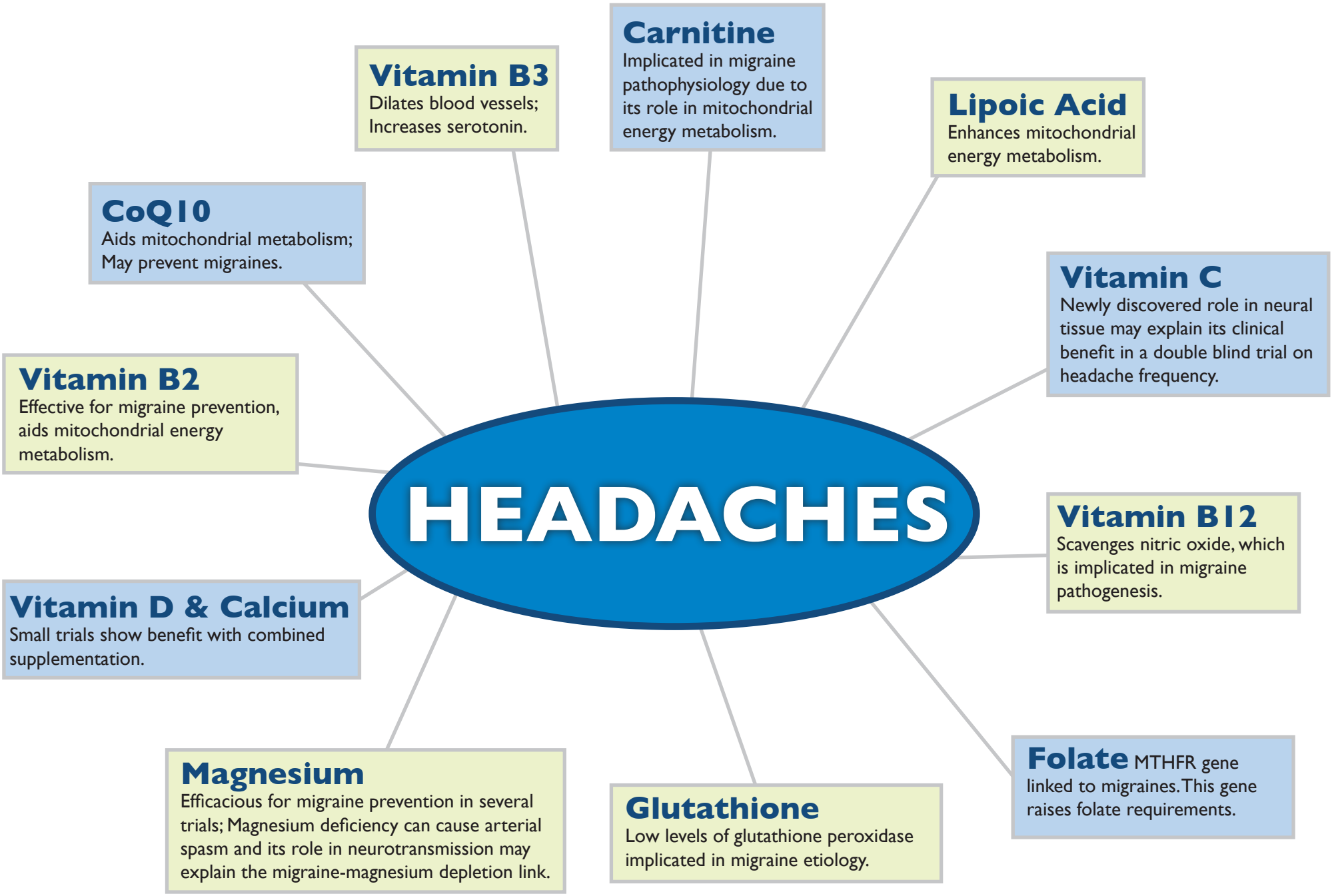

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Hypertension

Zinc Regulates angiotensin and endothelin, two enzymes that directly affect blood pressure; Deficiency causes blood vessels to constrict. [37,38]

Glutathione Oxidative stress, which often manifests as glutathione deficiency, can induce hypertension. [39,40]

Biotin Pharmacological doses reduce systolic blood pressure by activating an enzyme (cGMP) that causes smooth muscle to relax. [1,2]

Vitamin A Suppresses the growth of vascular smooth muscle, thus keeping blood vessels (lumen) clear and wide. [3,4]

Copper Regulates enzymes that keep blood vessels dilating properly; Depletion causes hypertension; Supplementation trials positive. [34,35,36]

Vitamin B2 People with a certain gene (called MTHFR type TT) tend to respond well to B2 therapy for lowering blood pressure. [5,6]

Magnesium Promotes dilation of blood vessels; Low intracellular levels are a well established cause of hypertension. [31,32,33]

Vitamin B6 Lowers homocysteine, a toxin that makes arteries stiff and raises blood pressure; Low B6 is strongly linked to hypertension. [6,7,8,9]

Vitamin C Improves the ability of blood vessels to react appropriately to relaxation signals; Increases nitric oxide, a powerful vasodilator. [9,10,11,]

Calcium Optimal calcium status reduces vasconstriction; Particularly effective for salt-sensitive hypertension as it increases sodium excretion. [9,29,30]

Vitamin D Low vitamin D is strongly linked to hypertension, possibly due to its role in calcium transport; Augments blood pressure lowering effect of calcium; Keeps blood vessels smooth and healthy. [9,12,13]

Folate Lowers blood pressure by improving endothelial function, or the ability of blood vessels to properly dilate. [27,28]

Vitamin E Increases nitric oxide synthase, an enzyme that causes blood vessels to dilate; Protects blood vessels from damage. [14,15]

Carnitine Lowers blood pressure in the same way as ACE inhibitors, a common hypertension drug which reduces angiotensin, a substance that causes arteries to constrict; Its role in fat metabolism explains this effect. [25,26]

Coenzyme Q10 Improves bioenergetics of blood vessel wall; Deficiency highly correlated to hypertension; Benefits of CoQ10 often not seen for several weeks. [9,16,17]

Oleic Acid The benefits of olive oil for blood pressure are largely due to its high oleic acid content, which protects endothelial cells (inner lining of blood vessels) from inflammation. [22,23,24]

Cysteine Anti-hypertensive effects stem from its role as a potent antioxidant; Effective vasolidator. [20,21]

Lipoic Acid Improves vascular tone; Causes vasolidation; Works like calcium channel blocker meds; Recycles vitamins C, E and Cysteine. [18,19]

Additional nutrients affect blood pressure. This list is non-exhaustive.

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HYPOTHYROIDISM

Glutathione
Hypothyroidism decreases efficacy of some antioxidants, such as glutathione peroxidase and superoxide dismutase.[1,2]

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).[3,4,5,6,7]

Choline
Hypothyroidism negatively affects choline function in the brain, which can affect mood and cognition.[29,30]

Vitamin C and E
Partially restores thyroid function when liver detoxification ability is compromised.[2,8,9,10,11]

Lipoic Acid
Improves endothelial function in people with subclinical hypothyroidism; Protects thyroid cells from oxidative stress; May interfere with T4 therapy.[27,28]

Vitamin A
Activates gene that regulates TSH (thyroid stimulating hormone).[12,13,14]

Carnitine
Decreased tissue levels of carnitine in both hypo- and hyperthyroidism contribute to muscle fatigue.[24,25,26]

Zinc
Increases thyroid hormone T3 in deficient subjects.[15,16,17,20,21]

Asparagine
This amino acid is part of the structure of thyroid stimulating hormone which regulates communication with other hormones.[22,23]

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.[18,19,20,21]

Copper
Low levels seen in experimentally induced hypothyroidism; Indirectly affects thyroid status by its antioxidant role via superoxide dismutase.[17]

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INFLAMMATION

Selenium
Subclinical deficiency negatively alters genes that regulate the inflammatory response; Deficiency promotes vascular inflammation. [37,38]

Manganese
Cofactor to the powerful antioxidant superoxide dismutase that fights inflammation within cells. [1,2]

Magnesium
Deficiency activates pro-inflammatory chemicals called cytokines; Deficiency will also kick start a damaging immune response by activating cells called leukocytes and macrophages. [3,4,5]

Glutathione
Repairs damage to cells caused by inflammation; Regulates the production of pro-inflammatory cytokines; Recycles vitamins C and E. [6,7]

Cysteine
Protects organs such as blood vessels, brain and liver from inflammatory damage; Precursor to glutathione production; Supplementation with N-acetyl cysteine raises glutathione. [8,9]

Copper
Deficiency lowers enzyme activity (such as superoxide dismutase) that fights inflammation; Lowers damaging isoprostanes, a by-product of inflammation. [34,35,36]

Vitamin C
Low vitamin C linked to inflammation; Inversely related to C-reactive protein (CRP), a marker for systemic inflammation; Increases glutathione. [10,11,12]

Zinc
Inflammation raises demand for zinc; Pro-inflammatory chemicals (cytokines) dose dependently decrease in response to zinc repletion. [31,32,33]

Vitamin D
Potent modulator of inflammation; Helps turn off chronic inflammatory responses; Inhibits pro-inflammatory cytokine production. [13,14]

Vitamin A
Regulates the cellular immune response to inflammatory signals; Deficiency increases the severity of chronic inflammation; Zinc depletion lowers vitamin A status. [28,29,30]

Vitamin E
Limits destructive cell behavior caused by inflammatory enzymes gone wild; Reduces damage from tumor necrosis factor alpha (TNF-α); Deficiency predisposes a person to inflammation-related diseases. [15,16]

Vitamin B2
Riboflavin (B2) helps minimize pain associated with inflammation; Detoxifies homocysteine, an amino acid that indirectly causes inflammation in various tissues. [26,27]

Vitamin B6
Low B6 status is linked to high levels of CRP and systemic inflammation. [24,25]

Coenzyme Q10
Decreases several inflammatory markers (CRP and IL-6) in supplementation trials; Affects genes that control response to inflammatory stress. [21,22,23]

Glutamine
Decreases cytokine production; Invokes an anti-inflammatory response; Precursor to glutathione. [19,20]

Lipoic Acid
Neutralizes free radicals caused by uncontrolled inflammation in both water and lipid phases of the cell; Protects endothelial cells from inflammation; Regenerates other antioxidants such as vitamin E, C and glutathione. [17,18]

Additional nutrients affect inflammation. This list is non-exhaustive.

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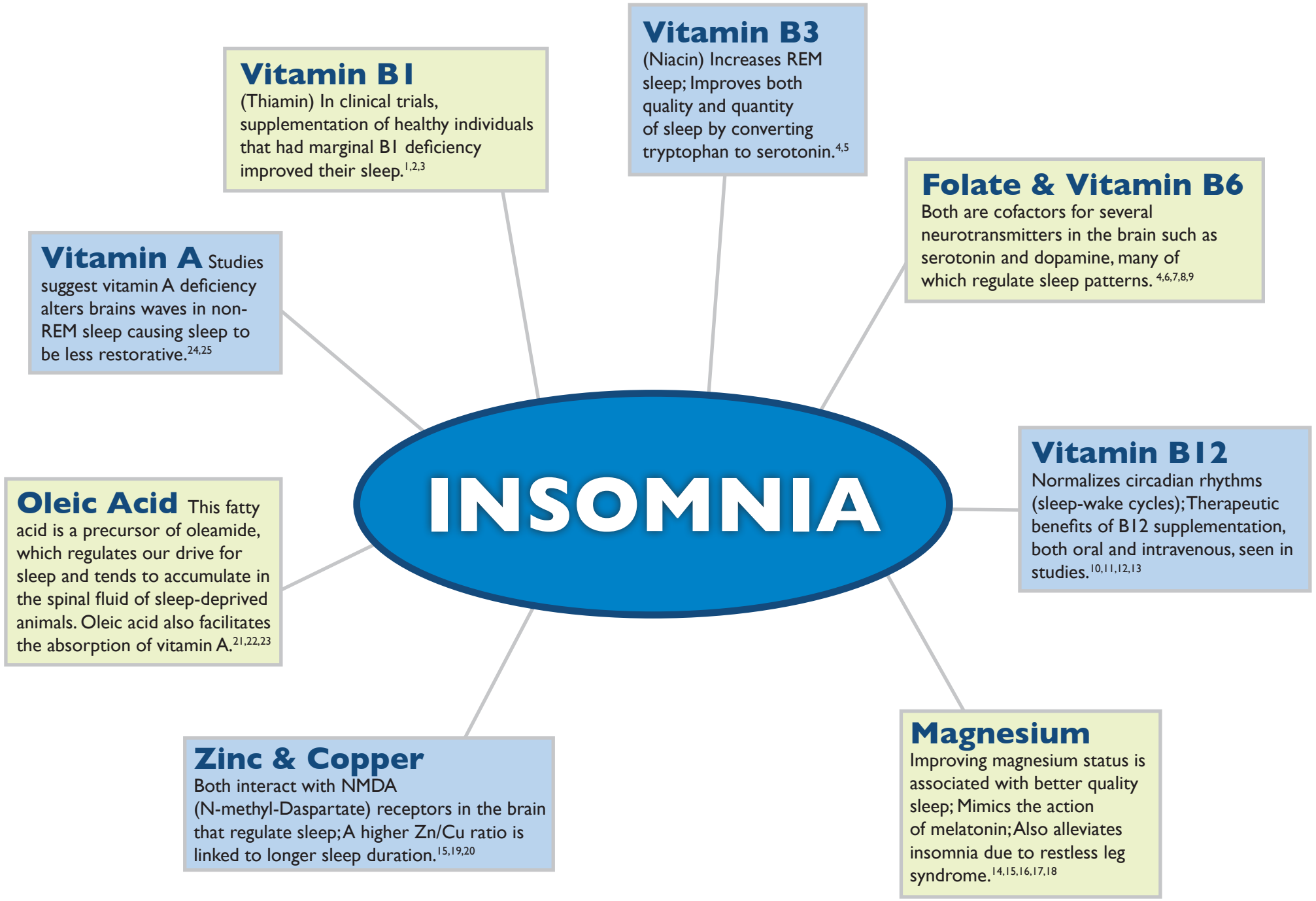

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METHYLATION

Vitamin B3
Maintains proper methylation of genes that suppress tumor formation and growth.[3,4,5,6]

Vitamin B6
Cofactor for the enzyme (serine hydroxyl methyl transferase) that transfers methyl units.[7,8]

Vitamin B12
B12 is a key enzyme needed in the synthesis of S-adenosylmethionine (SAMe), the body's most important methyl donor. Methionine synthase, an enzyme that catalyzes the methylation cycle is B12 dependent.[9,10,11]

Folate
Methyl donor for many reactions in the body, including neurotransmitter synthesis and conversion of homocysteine to methionine; Precursor to SAMe; Required for proper DNA synthesis.[12,13,14]

Vitamin B2
Helps recycle folate into a usable methyl-donor form; Precursor to FAD (flavin adenine dinucleotide) which assists methylation reactions.[1,2,3]

Choline
A major source of methyl groups (methyl donor); Deficiency linked to DNA damage.[15,16,17]

Serine
Important methyl donor, especially in the case of folate deficiency.[18,19,20]

Zinc
Deficiency can lower the ability to use methyl groups from methyl donors such as SAMe, thus causing global hypo-methylation of DNA.[32,33,34]

Glutathione
Deficiency impairs methylation reactions and hinders synthesis of the methyl donor SAMe.[21,22]

Vitamin C
Deficiency alters methylation patterns in cancer cells; Also a cofactor for methylating enzymes.[23,24]

Selenium
Inhibits a methylating enzyme (DNA methyltransferase) in cancer genes, effectively turning them off; Selenoproteins protect DNA and metabolize methionine.[30,31]

Magnesium
Its role in the methylation of genes that affect glucose metabolism may explain the link between magnesium deficiency and diabetes.[28,29]

Copper
Several key enzymes needed for methylation reactions are copper dependent.[25,26,27]

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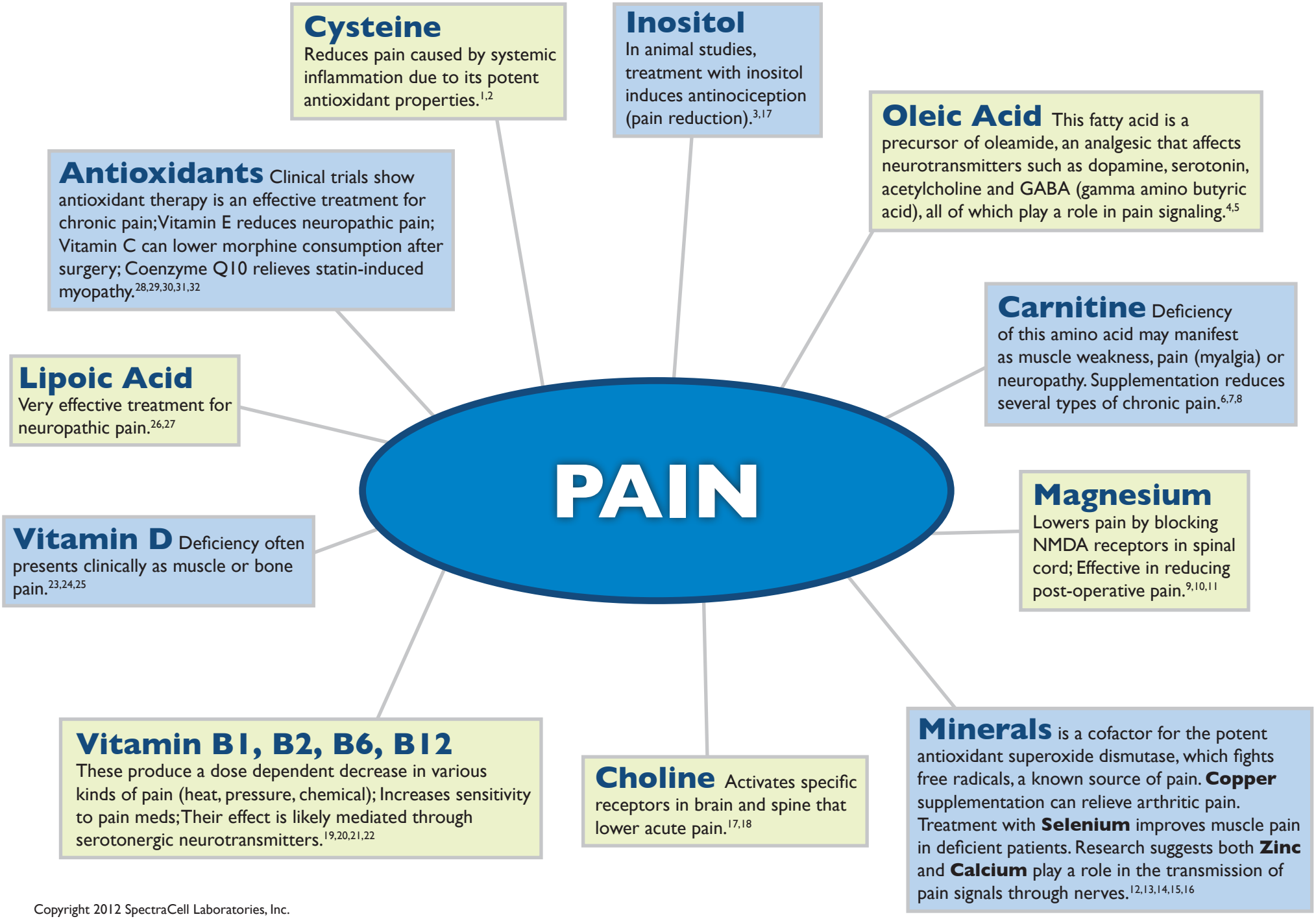

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SLEEP APNEA

Antioxidant Status
It is well documented that sleep apnea patients have both reduced antioxidant capacity and higher levels of oxidative stress than controls. [5,6,7,8]

Cysteine
Oral supplementation with cysteine, the precursor to glutathione, has therapeutic potential for sleep apnea. Snore time and duration were significantly reduced for patients treated with N-acetyl cysteine compared to untreated sleep apnea patients. [1,2,3,4]

Vitamin C
Improves endothelial function (blood vessel health) in sleep apnea patients to levels seen in people without sleep apnea. [9,10,11]

Vitamin E
Mitigates the oxidative stress seen in sleep apnea patients; Works synergistically with vitamin C. [5,11,12]

Glutathione
Low levels linked to sleep apnea; This powerful antioxidant helps repair liver damage caused by sleep apnea. [25,26,27]

Vitamin A
Sleep apnea patients have low retinol (vitamin A); Retinol suppresses the growth of vascular smooth muscle, a process that causes blood vessels to clog, linking low vitamin A levels to the cardiovascular complications seen in sleep apnea patients. [13,14]

Minerals
The trace minerals *zinc, copper, magnesium, manganese* and *selenium* are critical cofactors for the major antioxidant enzymes, which are important in repairing cellular damage caused by hypoxia (lack of oxygen) in sleep apnea. [23,24]

Vitamin D
People with sleep apnea have a high prevalence of vitamin D deficiency; The worse the apnea, the more severe the deficiency; Evidence suggests low vitamin D worsens sleep apnea's negative effect on heart disease risk. [15,16,17]

Copper
Considered a strong predictor of oxidative stress in sleep apnea patients; Copper's role as a key cofactor in the powerful antioxidant superoxide dismutase (SOD) explains this; SOD is very low in apnea patients. [21,22]

Selenium
In one case report, selenium supplementation completely stopped snoring caused by non-obesity sleep apnea; Selenium's role as a potent antioxidant may reduce the oxidative stress seen in sleep apnea patients. [18,19,20]

Additional nutrients affect sleep apnea. This list is non-exhaustive.

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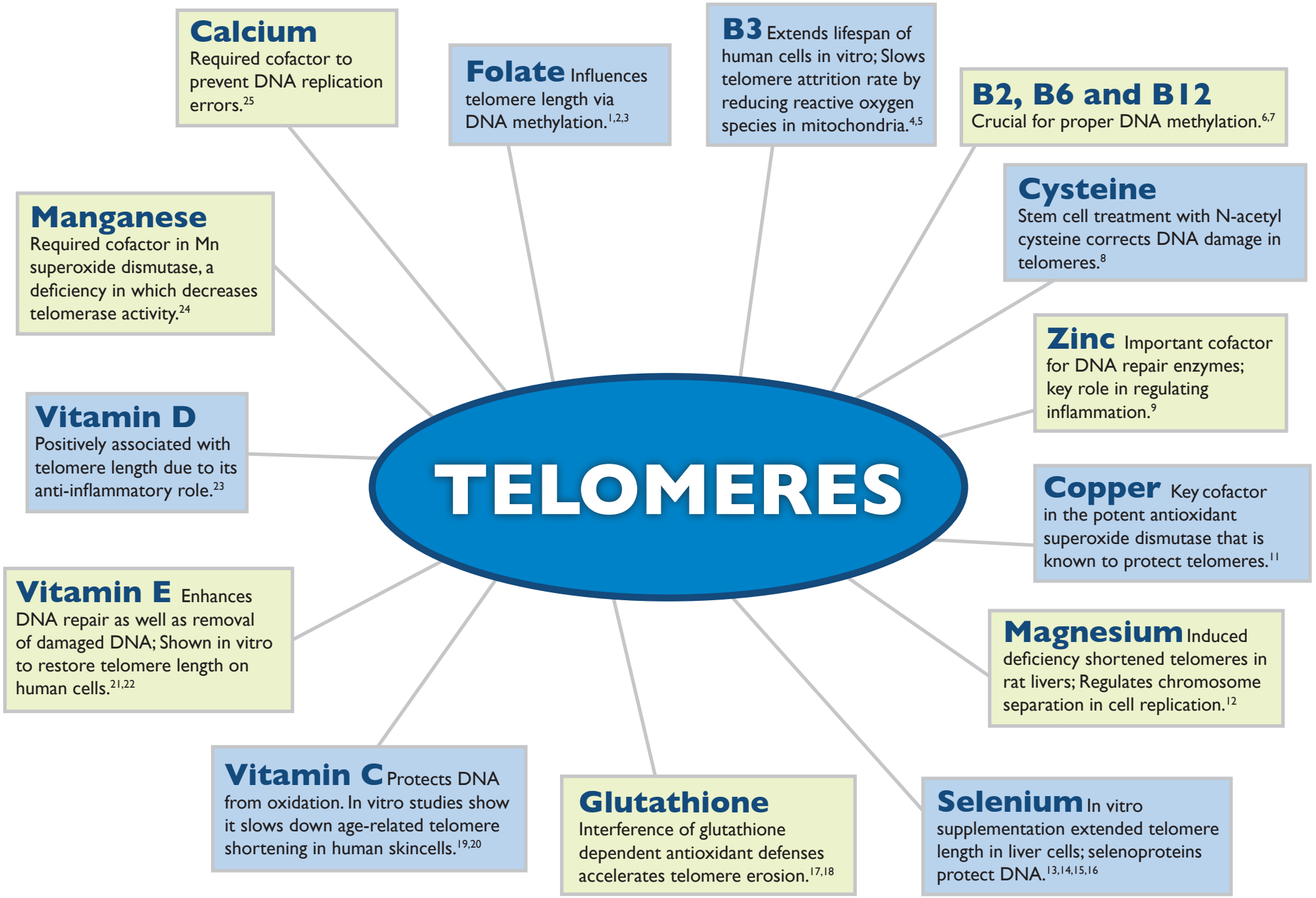

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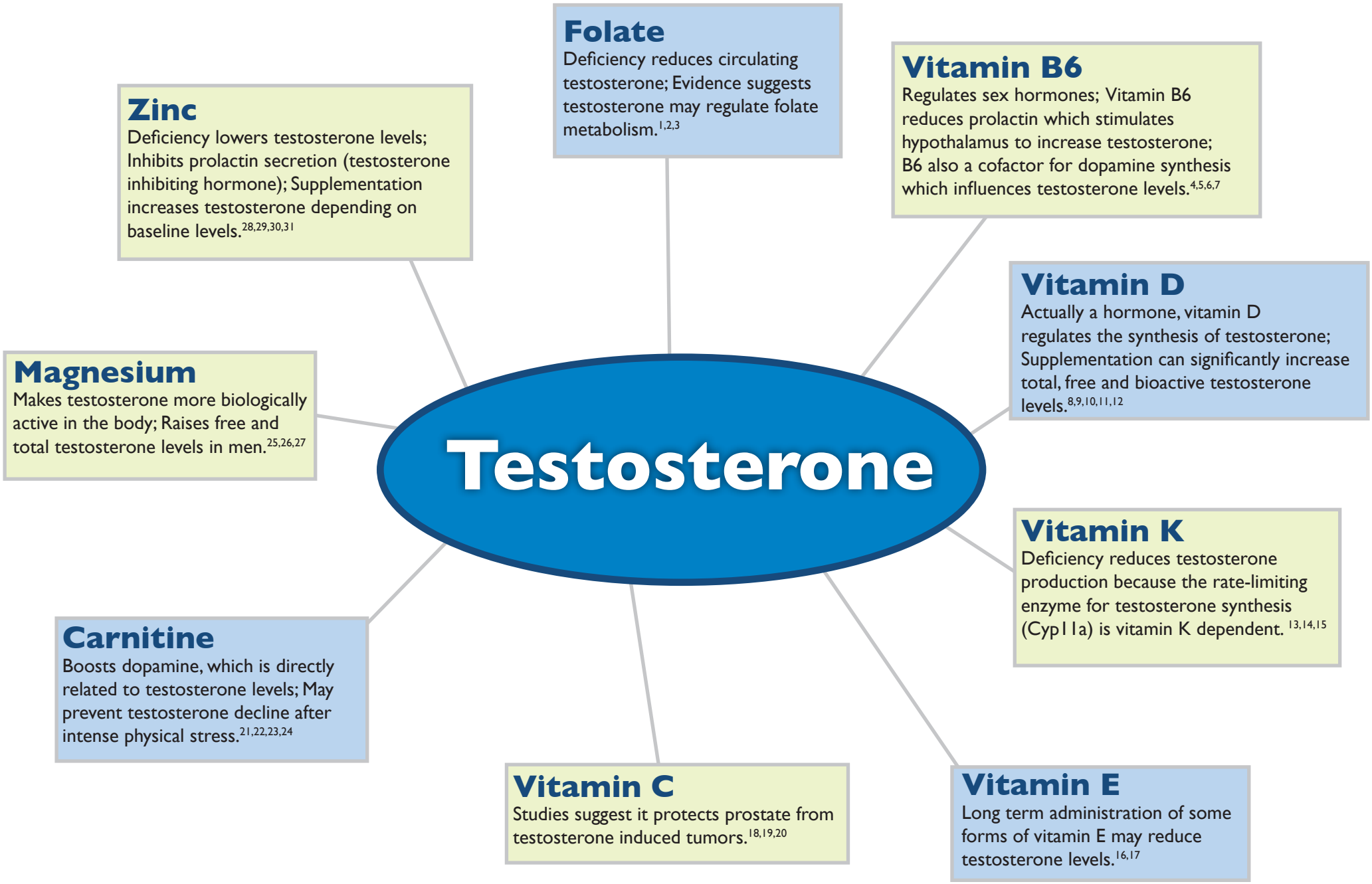

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WEIGHT MANAGEMENT

Asparagine
This amino acid increases insulin sensitivity which helps the body store energy in muscle instead of storing it as body fat.[1,2]

Biotin Boosts metabolism by improving glycemic control (stabilizes blood sugar) and lowering insulin, a hormone that promotes fat formation.[3,4,5]

Carnitine
Carries fatty acids into the cell so they can be burned for fuel; Helps reduce visceral adiposity (belly fat). [6,7]

Calcium Inhibits the formation of fat cells; Also helps oxidize (burn) fat cells.[8,9,10]

Zinc Deficiency of zinc reduces leptin, a beneficial hormone that regulates appetite, which is reversed by zinc repletion.[10,37]

Lipoic Acid Improves glucose uptake into cells, which helps a person burn carbohydrates more efficiently.[11,12,13]

Vitamin K
Poor vitamin K status linked to excess fat tissue; Vitamin K helps metabolize sugars.[35,36]

Chromium Makes the body more sensitive to insulin, helping to reduce body fat and increase lean muscle.[14,15,16,27,28,4]

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.[8,33,34]

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.[17,18]

Vitamin E Inhibits pre-fat cells from changing into mature fat cells, thus reducing body fat.[10,31,32]

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.[19,20,21]

Vitamin A
Enhances expression of genes that reduce a person's tendency to store food as fat; Reduces the size of fat cells.[10,29,30]

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.[26,27,28]

Inositol
Supplementation may increase adiponectin levels.[25]

Cysteine
Supplementation with this antioxidant reduced body fat in obese patients.[24]

Glutamine
Reduces fat mass by improving glucose uptake into muscle.[22,23]

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