Depression and other Neurotransmitter Related Conditions - The Mercury Connection

Bernard Windham (Ed.)

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1.1 Introduction

There are several types of depression and mood disorders, including neurotic depression, manic-depression, postpartum depression, anxious depression, agitated depression/panic attacks, obsessive-compulsive disorder, attention deficit disorder, etc. This review covers all of these disorders to some degree. Prescription and over the counter drugs that commonly are a factor in depressive disorders include Accutane, Acid blockers, Alprazolam, Ambien, Anabolic steroids, Beta-blockers, birth control pills, butalbital, chemotherapy, digoxin, hormone replacement drugs, pednisone, Quinalone antibiotics, Valium, etc., so this should be taken into account (20).

According to Dr. Gerald Klerman, based on National Institute of Health studies there has been a huge increase (over 500%) in the rate of depression and chronic neurological problems over the last 3 decades. A random sample of Oregon high school students found that over 16% had been diagnosed with depression (10). According to ECA samples, otherwise healthy people born in recent decades face a 10 fold increase in incidence of major depressive episodes compared to those sampled who were born in earlier decades. Over 6 million Americans over 65 suffer from major depression while another 5 million suffer from depressive symptoms (598). Every year, at least 230 million prescriptions for antidepressants are filled, making them one of the most prescribed drugs in the United States. The psychiatric industry itself is a $330 billion industry.

Several factors appear to be contributing to this:

1. neurological birth defects and developmental conditions due to increased levels of vaccinations, fetal exposure to alcohol, tobacco smoke, drugs, *toxic metals*[1] such as lead, mercury, cadmium,

[1] **Informativo:** "Effects of Toxic Metals on Learning Ability and Behavior".

etc., other neurotoxic chemicals such as pesticides (552, 585), nitrates, etc., and other *endocrine system*[2] / hormonal system disrupting chemicals such as dioxins, phythalates (12), etc. Studies by the *National Academy of Sciences*[3] indicate that these affect close to 40% of all children in the U.S., more in some populations than others

2. changes in dietary habits resulting in nutrient, vitamin, and mineral deficiencies or imbalances and blood sugar imbalances (596), and increased consumption of inflammatory excitotoxins such as aspartame, MSG, and high fructose corn syrup

3. stress in family and workplace environments.

Groups of primary care patients aged 18-65 years from 333 randomly chosen public or private clinics throughout the whole country of Poland, totaling 7289, coming for a regular visit were asked to participate in a study of the prevalence of depressive disorders (6). 71% of the sample were female. All patients filled in the Beck Depression Inventory (BDI). The prevalence of depressive disorders in the whole sample was 23.3%.

The number of people with anxiety disorders is close to the number with mood disorders (584). The primary types of anxiety disorders are phobias, panic attacks, generalized anxiety disorder (GAD), and obsessive-compulsive disorder (OCD). At least 20 million people are affected at some time by these conditions. Similar large numbers are affected by attention disorders, including attention deficit hyperactive disorder (ADHD), dyslexia, and schizophrenia (580, 584). "The Centers for Disease Control is out with a new survey that shows 5.4 million schoolchildren have been diagnosed with attention-deficit/hyperactivity disorder (AD/HD). That's 10%." In fact "from the years 2003 to 2007, the number of kids between four and ... 17 with AD/HD jumped by one million. That's a 22% increase." (180) However large surveys of elementary level student records finds much higher levels - with over 20% of elementary school boys in some areas being treated for ADD (143, 180). Similar levels of children have been found to have mood or anxiety disorders. At least 4% of adults have also been found to have ADHD symptoms (176). Studies have found that long term use of stimulant drugs commonly are not effective in the long run and causes significant adverse neurological and health effects (145, 172, 594b), There are more effective options available to deal with such conditions without such adverse effects including dealing with the underlying causes (172, 173, 176, 177) and diet, exercise, and supplement options that deal with underlying deficiencies (172).

Twenty-plus years of research on antidepressants, from the old tricyclics to the newer selective serotonin reuptake inhibitors (SSRIs) show that their benefit is hardly more than what patients get when they take a placebo (30, 31, etc.) Also that they don't deal with some of the main causes of depression. Long-term increased stress hormones such as cortisol appear to often be a larger factor in depressive conditions than reduced serotonin (20, 594, etc.). In Britain, the agency that assesses which treatments are effective enough for the government to pay for stopped recommending antidepressants as a first-line treatment, especially for mild or moderate depression. A spokesperson for Pfizer, which makes Zoloft, added that the fact that antidepressants "commonly fail to separate from placebo is a fact well known by the FDA, academia, and industry." Antidepressants are significantly more effective than a placebo in patients suffering only from the most severe depression (31). The serotonin-deficit theory of depression is built on a hypothesis that has little support. And a new drug, tianeptine, which is sold in France and some other countries (but not the U.S.), turns out to be as effective as Prozac-like antidepressants that keep the synapses well supplied with serotonin even though the mechanism of the new drug is to lower brain levels of serotonin. "If depression can be equally affected by drugs that increase serotonin and by drugs that decrease it", says Kirsch (30c), "it's hard to imagine how the benefits can be due to their chemical activity." SSRIs often provide temporary improvement in some depressive conditions, but there effects usually don't last over time

[2]**Internet:** "http://www.flcv.com/endocrin.html".
[3]**Informativo:** "Effects of Toxic Metals on Learning Ability and Behavior".

and the often cause loss of sex drive and other adverse effects (20, 594b). Exercise, diet modification including reduction of sweets, and supplementing deficient vitamins and minerals have been found more effective treatments in the long term (20, 594, etc.) Supplements found to often help adrenal fatigue include, licorice extract, Panax ginseng, DHEA, Rhodiola, pantehine, and Eleuthero (20). Exercise routines found to be helpful include walking, yoga, and pilates (20). Since 1996, scientific researchers and doctors in clinical practice have been studying the effects of EMPowerplus mineral supplementation program on mental and mood disorders such as bipolar disorder. Results have been very encouraging and significant (522). Low cellular levels of the omega-3 oil DHA have also been found to be associated with bipolar disorder (21b).

1.2 Causes of Depression and Anxiety

There appears to be both a psychological/mind basis as well as physical/chemical basis for depression and anxiety. Nutritional deficiencies, environmental factors, methylation deficiencies, hormonal imbalances, and stress clearly can lead to depression and anxiety, but they also facilitate psychological factors (386, 493, 580, etc.). Based on clinical experience, anxiety and hyperventilation and panic attacks appear to often be related to a person burying their feelings about their circumstances (583). Depression often occurs where a person has suppressed anger, anger turned inward. Chronic anger has been found to be linked to increased risk of recurrent heart attacks and cardiac death (583b). The brain amygdala controls fear and anger and inflammatory conditions such as excess glutamate or stress have been found to reduce its control and to increase anger or fear (594). Other heart risks have also been linked to depression, anxiety, repressed anger and isolation or infrequent social interactions (582b). These factors, which lead to increased risks of heart disease, have been correlated with elevated cholesterol, blood pressure, variable heart rate plus increased arterial thickness and plaque accumulation. And studies estimate that 20 to 40 percent of all sudden cardiac deaths will be triggered by some type of acute emotional stressor (582c). Dealing with nutritional deficiencies and environmental factors, along with being honest with yourself, acknowledging anger or feelings rather than assigning blame, and doing what makes you feel good usually leads to reduced depression or anxiety (583a, 493).

The levels of brain neurotransmitters such as dopamine, norepinephrine, and serotonin, appear to be major factors in controlling moods, and appear to be affected by lifestyle, diet, philosophy, and environmental factors. Some are more susceptible to depression than others, and thus more affected by diet and environmental factors (580).

Chronic or acute brain inflammation appears to be a primary factor in depression. The brain is very sensitive to inflammation. Disturbances in metabolic networks: e.g., immuno-inflammatory processes, insulin-glucose homeostasis, adipokine synthesis and secretion, intra-cellular signaling cascades, and mitochondrial respiration have been shown to be major factors in depressive disorders and other chronic neurological conditions (592, 593, 598, etc.).

Inflammatory chemicals such as mercury, aluminum, and other toxic metals as well as other excitotoxins including MSG and aspartame cause high levels of free radicals, lipid peroxidation, inflammatory cytokines, and oxidative stress in the brain and cardiovascular systems (13, 594, 596-599) Overexposure to heavy metals like lead, mercury, copper, and zinc have been shown to induce anxiety or depression (386a, 586, 493, 494, 593, 594). Accumulation of mercury in the brain limbic system with resulting oxidative stress and inflammation has been found to commonly be a factor in depression (303).

Studies have found that oxidative stress from reactive oxygen species (such as caused by mercury and toxic metals) causes increased insulin resistance, whereas reducing reactive oxygen species lowers insulin resistance. (15). Insulin resistance has been found to be a significant factor in metabolic syndrome, cognitive decline, cardiovascular disease, depression, cancer, etc. Mercury and cadmium

inhibit magnesium and zinc levels as well as inhibiting glucose transfer. Reduced levels of magnesium and zinc are related to metabolic syndrome, insulin resistance, and brain inflammation and are protective against these conditions (599, 43). These are additional mechanisms by which mercury and toxic metals are factors in metabolic syndrome and insulin resistance and conditions such as diabetes, depression, etc. (43, 196, 338, 597, 15a). As documented later, for those who have several amalgam fillings, replacement of the amalgam greatly lowers mercury and toxic metal exposure, lowers reactive oxygen species and related damage, and brings significant improvement in the health of people with conditions caused by oxidative damage and insulin resistance. It has also been documented that supplementation with antioxidants such as green tea extract, bilberries, curcumin, N-acetyl-cysteine, etc. and supplements such as DHEA, Goat's Rue, cinnamon, quercetin, and vanadyl sulfate reduces inflammatory cytokine effects and lowers insulin resistance (15a).

Many studies have found toxic metal exposure such as mercury, lead, cadmium, and manganese commonly causes depression and other mood and neurological disorders (586). Young adults with higher blood lead levels are more likely to have major depressive disorder (MDD) or panic disorder, even if they have exposure to lead levels generally considered safe (586b)

The brain has elaborate protective mechanisms for regulating neurotransmitters such as glutamate, which is the most abundant of all neurotransmitters. When these protective regulatory mechanisms are damaged or affected, chronic neurological conditions such as Parkinson's can result (593). Mercury and other toxic metals inhibit astrocyte function in the brain and CNS (119), causing increased glutamate and calcium related neurotoxicity (119, 333, 416, 496, 594). Mercury and increased glutamate activate free radical forming processes like xanthine oxidase which produce oxygen radicals and oxidative neurological damage (142, 13). Nitric oxide related toxicty caused by peroxynitrite formed by the reaction of NO with superoxide anions, which results in nitration of tyrosine residues in neurofilaments and manganese Superoxide Dimustase (SOD) has been found to cause inhibition of the mitochondrial respiratory chain, inhibition of the glutamate transporter, and glutamate-induced neurotoxicity involved in ALS (524, 521). Excess extracellular glutamate has been found to be strongly related to neurological conditions such as Alzheimer's, Parkinson's, ALS, OCD, depression, etc.(587b, 594). Psychotrophic drugs that were thought to alleviate depression by raising monoamine levels have now been found to work by inhibiting glutamate receptors, thus reducing inflammation (587c). Hypericin, the active ingredient in St John's Wort used to treat depression also has been found to inhibit the release of glutamate into the brain and protect against excitotoxicity (588).

These inflammatory processes damage cell structures including DNA, mitochondria, and cell membranes. They also activate microglia cells in the brain, which control brain inflammation and immunity. Microglia are the main immune cells in the brain. Once activated, the microglia secrete large amounts of neurotoxic substances such as glutamate, an excitotoxin, which adds to inflammation and stimulates the area of the brain associated with anxiety (594, 598). This has been called immunoexcitotoxicity (594), which has been demonstrated to be a significant factor in many chronic psychiatric disorders including schizophrenia, PTSD, autism, suicides. Inflammation also disrupts brain neurotransmitters resulting in reduced levels of serotonin, dopamine, and norepinephrine. Some of the main causes of such disturbances that have been documented include vaccines, mercury, aluminum, other toxic metals, MSG, aspartame, other food additives, etc. (593, 594, 598, 600) Studies have shown that an increase in the inflammatory biomarker CRP (C-reactive protein) predicts the onset of depression in elderly people who had no prior history of depression (587a), and that depression is also linked with high levels of other inflammatory biomarkers - such as IL-6 (594). Inflammation also causes reduced levels and/or reduced effectiveness of the main brain-calming neurotransmitter, GABA (594). It is the balance between brain excitatory neurotransmitters like Glutamate and the calming neurotransmitters like GABA that allows normal functioning, and imbalances lead to psychiatric disorders.

Excitotoxic exposures and food additives are extremely common and affect most children, and can have major impacts on the brain over time, resulting in faulty brain-wiring, magnified aggressiveness,

rage reactions, obsessions, panic attacks, and other neurological and mood disorders (594). Studies have found that food-based excitotoxins can raise brain glutamate levels by as much as a factor of 50, causing inflammation and resulting in damage to the brain and brain regulatory mechanisms over time. This is especially true of the prefrontal cortex which controls judgement, regulates risk-taking, and suppresses socially inappropriate behavior. A study found that those with bipolar disorder have much lower levels than normal of the omega-3 DHA in the orbitofrontal cortex area of the brain which regulates behavior (21b). Those most susceptible to such excitotoxic effects are babies and the elderly, and also especially damaging for those who suffer from reactive hypoglycemia. Studies have found that eliminating such food-based excitotoxins in school diets resulted in greatly reduced behavioral problems and inattention problems (594b). The majority of the body's immune system is found in the digestive system, and inflammatory bowel diseases and food intolerances which induce inflammation in the intestines have also been found to be factors in brain inflammation and related psychiatric disorders (594b).

It had been thought that low serotonin levels in the brain were a major factor in depression, because inflammatory disorders (or infections) cause measured serotonin levels in the blood to fall significantly. However further studies have found that inflammation activates microglia (589a), which metabolize the serotonin precursor tryptophan into the highly brain-toxic excitoxin quinolinic acid (589b); while also reducing the number of astrocytes, which metabolize tryptophan into a brain protective chemical kynurenine (589c). This imbalance has been found to be associated with psychiatric conditions such as depression and anxiety disorders (594). It has also been found that those with depression or anxiety disorders have low levels of a the brain-protective substance brain growth stimulator factor (BDGF) (589d). This is supplied by the astrocytes, which have been seen to be decreased in inflammatory conditions such as depression. Seratonin, which is also decreased, stimulates the release of BDGF. The mineral zinc has also been found to increase BDGF as well as the protective substance BDNF, and to reduce excitotoxicity (594), though its also possible to get too much zinc. Zinc deficiency can cause conditions such as depression, and zinc supplementation can improve depression in such circumstances. A persons zinc status can be determined through hair test or red blood cell test.

Hormone imbalance has been found to be a common factor in depression and learning disabilities (488, 12b), and thyroid imbalances have also been found to cause depression and ADHD (386a, 553, 20, 12b). Mercury and other endocrine disrupting chemicals such as phthalates have been found to commonly cause hypothyroidism (553, 12b). Imbalances in DHEA and cortisol may underlie depression, particularly when stress and obesity are present. Estrogen imbalances in post-menapausal women, low testosterone levels in some men, low DHEA levels, and hypothyroid conditions have been found to be common factors in depression. Subclinical hypothyroidism and/or the presence of thyroid peroxidase antibodies (TPOAb) has been found to be associated with subfertility, infertility, spontaneous abortion, placental abruption, preterm delivery, gestational hypertension, preeclampsia, postpartum thyroid dysfunction, depression (including postpartum depression), and impaired cognitive and psychomotor child development (7). It is recommended to suspect thyroid pathology if such conditions are present.

Most studies support a relationship between thyroid state and cognition, particularly slowed information processing speed, reduced efficiency in executive functions, and poor learning (11). Furthermore, hypo-thyroidism is associated with an increased susceptibility to depression and reductions in health-related quality of life. Controlled studies suggest that cognitive and mood symptoms improve with thyroid treatment, though the data are limited by diverse treatment methodologies. Functional neuroimaging data provide support for the mood and cognitive findings and treatment reversibility for both overt and subclincial hypothoidism (11a). 94 patients with subclinical hypothyroidism and a control group were evaluated to determine the prevalence of psychiatric disorders (11b). The prevalence of depressive symptoms based on Beck's Scale among subclinical hypothyroidism patients was about 2.3 times higher than among controls (45.6% vs 20.9%, $p = 0.006$). Anxiety symptoms

were also more frequent in the hypothyroid group.

Postpartum thyroiditis (PPT) is the occurrence, in the postpartum period, of transient hyperthyroidism and/or transient hypothyroidism, with most women returning to the euthyroid state by 1 year postpartum (8a). However PPT frequently reoccurs in subsequent pregnancies and approximately 25% of women with a history of PPT will develop permanent hypothyroidism in the ensuing 10 years. The mean prevalence of PPT in 2 studies was 7.5%. Postpartum thyroiditis is an autoimmune disorder, and thyroid antibody-positive women in the first trimester have a 33% to 50% chance of developing thyroiditis in the postpartum period. There was a 70% chance of developing recurrent PPT after a first attack, and a 25% risk even in women who were only anti-TPO positive without thyroid dysfunction during the first postpartum period (8b). For this group of women with PPT, 46% had postpartum depression in one or more pregnancies.

In a study of effects of hypothyroid or thyroiditis during pregnancy, infants of women with hypothyroxinemia at 12 weeks' gestation had significantly lower scores on the Neonatal Behavioral Assessment Scale orientation index compared with normal subjects (9). Regression analysis showed that first-trimester maternal free thyroid hormone was a significant predictor of orientation scores. This study confirmed that maternal hypothyroxinemia constitutes a serious risk factor for neurodevelopmental difficulties that can be identified in neonates as young as 3 weeks of age. **Because of such evidence**, in November 2002, the American Association of Clinical Endocrinologists (AACE) recommended screening all women considering conception and/or all pregnant women in the first trimester for thyroid dysfunction (7b).

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As will be shown, there is considerable evidence that depression/neurological problems can be caused by many physiological problems related to past toxic exposures or combinations of these. Where physiological problems are contributing factors, determination of the underlying cause from assessing the persons past medical history, diet, blood tests, hair tests, etc. can be useful to identifying and correcting any nutritional deficiencies or imbalances (386a) or identifying other problems to be dealt with. There is considerable evidence mercury exposure is among the most common significant exposures that commonly cause such effects, although many are also exposed to lead (586), arsenic, and pesticides (552, 585) that have similar effects and effects are *synergistic*[4] or cumulative.

1.3 Mercury exposure levels from amalgam and other sources

Amalgam fillings have been documented to leak significant levels of mercury continuously due to high vapor pressure of mercury and galvanic action between mixed metals in the mouth (600, 602). The average person with several fillings gets significant exposure of mercury daily, much *more than from any other source*[5] and more than that prescribed by U.S. Government health guidelines (602). Mercury in pregnant women is also documented to cross the placenta and accumulate in the *fetus*[6] to levels higher than in the mother (603). Since mercury from amalgam fillings of a mother is also transmitted to nursing infants in significant amounts, mercury from their mom's dental fillings has been found to be the *largest source of mercury*[7] to the fetus and a significant source of mercury in infants, which has produced developmental problems that affect children later in life (603). Young children also have been receiving significant levels of mercury (thimerasol which is used as a preserva-

[4]**Internet:** "http://www.flcv.com/synergis.html".

[5]**Informativo:** "Dental Amalgam Mercury Solutions".

[6]**Informativo:** "Infertility, Birth Defects, and Fetal Developmental Effects Related to Mercury from Amalgam Dental Fillings & Other Toxins".

[7]**Informativo:** "Infertility, Birth Defects, and Fetal Developmental Effects Related to Mercury from Amalgam Dental Fillings & Other Toxins".

tive in vaccines) and large numbers have been found to be significantly adversely affected because of receiving larger numbers of vaccinations, especially at very early ages before the blood-brain barrier matures (602). People also get significant prenatal and postnatal exposures to other toxic metals such as lead, arsenic, cadmium, aluminum, etc. which have also been found to commonly cause significant neurological effects (586, 604) . The top 3 toxic substances affecting large numbers of people in the U.S. adversely according to EPA/ATSDR are mercury, lead, and arsenic. (600, 604).

A 2009 study found that inorganic mercury levels in people have been increasing rapidly in recent years (543b). It used data from the U.S. Centers for Disease Control and Prevention's National Health Nutrition Examination Survey (NHANES) finding that while inorganic mercury was detected in the blood of 2 percent of women aged 18 to 49 in the 1999-2000 NHANES survey, that level rose to 30 percent of women by 2005-2006. Surveys in all states using hair tests have found dangerous levels of mercury in an average of 22% of the population, with over 30% in some states like Florida and New York (543c). A large U.S. Centers for Disease Control epidemiological study, NHANES III, found that those with more amalgam fillings (more mercury exposure) have significantly higher levels of chronic health conditions (543). The conditions in which the number of dental amalgam surfaces were most highly correlated with disease incidence were MS, epilepsy, migraines, mental disorders, diseases of the nervous system, disorders of the thyroid gland, cancer, and infectious diseases (543).

1.4 Toxic and immune reactive effects of mercury

Mercury is neurotoxic (kills or damages brain and nerve cells): (19, 27, 34, 36, 43, 69, 70, 147, 148, 175, 207, 211, 273, 291, 295, 327, 329, 301, 303, 395, 600/ 39, 262, 274, 303); generates high levels of reactive oxygen species (ROS) and oxidative stress, depletes gluatathione and thiols causing increased neurotoxicity from interactions of ROS, glutamate, and dopamine (13, 56, 98, 102, 126, 145, 169, 170, 184, 213, 218, 219, 250, 257, 259, 286, 290, 291, 302, 324, 326, 329, 594, 600); kills or inhibits production of brain tubulin cells (66, 67, 161, 166, 207, 300); inhibits production of neurotransmitters by inhibiting: calcium-dependent neurotransmitter release (372), dihydroteridine reductase (27, 122, 257), nitric oxide synthase (259), blocking neurotransmitter amino acids (438, 601), and effecting phenylalanine, tyrosine and tryptophan transport to neurons) (34, 122, 126, 257, 285, 288, 333, 438, 495/255, 333). Toxic metals as well as genetic factors commonly cause systemic methylation deficiencies (88), which are documented to commonly be a factor in chronic conditions such as depression, autism, etc. (386a)

Numerous studies have found long-term chronic low doses of mercury cause neurological, memory, behaviour, sleep, and mood problems (5, 72, 74, 107, 109, 290, etc.). Neurological problems are among the most common and serious effects of mercury, and include memory loss, moodiness, depression, anger and sudden bursts of anger/rage, self-effacement, suicidal thoughts, lack of strength/force to resolve doubts or resist obsessions or compulsions, etc. Many studies of patients with major neurological diseases have found evidence amalgam fillings may play a major role in development of conditions such as depression (94, 107, 109, 212, 222, 229, 233, 285c, 294, 317, 320, 322, 372, 374, 453), schizophrenia (34, 35, 295, 601), memory problems (70, 94, 212, 222, 600), and other more serious neurological diseases such as MS, ALS, Parkinson's, and Alzheimer's (13, 33, 66, 98, 207b, 330, 331, 424, 438, 483, 600). Some factors that have been documented in depression are low serotonin levels, abnormal glucose tolerance (hypoglycemia), and low folate levels (480-83), which mercury has also been found to be a cause of. Occupational exposure to mercury has been documented to cause depression and anxiety (534). Acute exposure to mercury vapor has been found to cause chronic depression, anxiety, and obsessive-compulsive behavior (487). One mechanism by which mercury has been found to be a factor in aggressiveness and violence is its documented inhibition of the brain transmitter acetylcholinesterase (175, 451, 465, 254). Low serotonin levels and/or hypoglycemia have also been found in the majority of those with impulsive and violent behavior (481, 482).

Mercury (and other toxic metals) has been found to accumulate in the pineal gland and reduce melatonin levels, which is thought to be a significant factor in mercury's toxic effects (569). Melatonin has found to have a significant protective action against methyl mercury toxicity, likely from antioxidative effect of melatonin on the MMC induced neurotoxicity (567). Disrupted sleep from low melatonin, or 'Seasonal Affective Disorder' with excessive melatonin production, can result in depression (386a). Melatonin is important in regulating mood and improving sleep and increasing quality of life by regulating your body's circadian rhythms-while scientific evidence indicates that it has helpful anti-inflammatory and antioxidant properties that can support your heart, too (564).

There is also evidence that mercury affects neurotransmitter levels which have effects on conditions such as depression, mood disorders, ADHD, etc. There is evidence that mercury can block the dopamine_b-hydroxylase (DBH) enzyme (571). This enzyme synthesizes noradrenaline, and low noradrenaline can cause fatigue and depression. Mercury molecules can block all copper-catalysed dithiolane oxidases, such as coproporphyrin oxidase and DBH. Mercury and other toxic metals have been found to accumulate in the pineal gland and reduce melatonin levels, which is thought to be a significant factor in mercury's toxic effects (569).

There is evidence that mercury can block the dopamine-beta-hydroxylase (DBH) enzyme (571). DBH is used to make the noradrenaline neurotransmitter and low noradrenaline can cause fatigue and depression. Mercury molecules can block all copper catalyzed dithiolane oxidases, such as coproporphyrin oxidase (260) and DBH.

Workers occupationally exposed to mercury at levels within guidelines have been found to have impairment of lytic activity of neutrophils and reduced ability of neutraphils to kill invaders such as candida (285, 404). The balance of yeasts found in the intestine can be a factor in neurological conditions such as depression (386a, 404). Evidence suggests Candida albicans may activate depressive symptoms and fatigue by promoting ethanol production, a known central nervous system depressant. Behavior changes are also associated with Candida's inherent toxin - canditoxin - and/or by its tendency to compete with the host organism for essential dietary nutrients.(460) Immune Th1 cells inhibit candida by cytokine related activation of macrophages and neutraphils. Development of Th2 type immune responses deactivate such defenses (404b, 285). Mercury inhibits macrophage and neutraphil defense against candida by its affects on Th1 and Th2 cytokine effects (181, 285). Candida overgrowth results in production of the highly toxic canditoxin and ethanol which are known to cause fatigue, toxicity, and depressive symptoms (460).

Mercury causes decreased lithium levels, which is a factor in neurological diseases such as depression and Alzheimer's. Lithium protects brain cells against excess glutamate and calcium, and low levels cause abnormal brain cell balance and neurological disturbances (280, 294, 333, 33, 56). Medical texts on neurology (27, 295) point out that chronic mercurialism is often not recognized by diagnosticians and misdiagnosed as dementia or neurosis or functional psychosis or just "nerves". "Early manifestations are likely to be subtle and diagnosis difficult: Insomnia, nervousness, mild tremor, impaired judgment and coordination, decreased mental efficiency, emotional lability, headache, fatigue, loss of sexual drive, depression, etc. are often mistakenly ascribed to psychogenic causes". Very high levels of mercury are found in brain memory areas such as the cerebral cortex and hippocampus of patients with diseases with memory related symptoms (158, 34, 207, etc).

A direct mechanism involving mercury's inhibition of cellular enzymatic processes by binding with the hydroxyl radical (SH) in amino acids appears to be a major part of the connection to neurological conditions such as autism, schizophrenia, manic-depressive, ADD, depression (294, 375, 408, 438, 601). For example mercury has been found to strongly inhibit the activity of dipeptyl peptidase (DPP IV) which is required in the digestion of the milk protein casein (411, 412, 602). Studies involving a large sample of schizophrenic or autistic patients found that over 90% of those tested had high levels of the milk protein beta-casomorphin-7 in their blood and urine and defective enzymatic processes for digesting milk protein (410). Similar findings have been confirmed for ADD

and mania patients. Elimination of milk products from the diet has been found to improve these conditions in large numbers of patients (5). Such populations have also been found to have high levels of mercury and to recover after mercury detoxification. (413, 60, 313, 600). As mercury levels are reduced the protein binding is reduced and ment in the enzymatic process occurs (5). Additional cellular level enzymatic effects of mercury's binding with proteins include blockage of sulfur oxidation processes and neurotransmitter amino acids (33, 114, 438, 5), enzymatic processes involving vitamins B6 and B12 (418, 5), effects on the cytochrome-C energy processes (232, 35), along with mercury's adverse effects on cellular mineral levels of calcium, magnesium, zinc, chromium, and lithium (43, 96, 198, 333, 386, 427, 432, 484, 38).

When a pathological state exists, the body's finely balanced symbiosis may be damaged and cease to function normally. Beneficial essential bacteria may be damaged, causing the malabsorption of critical vitamins and minerals. If the damage is extensive and/or long lasting, pathogens including pathogenic yeast and gram negative bacilli will begin to fill the vacuum left by the healthy bacteria. The metabolism of these pathogens is different and foods are no longer broken down in the same way. Proteins that previously would be broken down to their constituent amino acids are only partially digested, leaving long chains of amino acids called peptides. Our entire body is built from proteins, which are themselves built from chains of peptides. Certain peptides are extremely bioactive i.e they interact strongly with other proteins in the body. Mercury and toxic metals cause dysbiosis and inhibits the function of the enzymes needed to digest gluten and casein, resulting in peptides in the blood which have significant neurological effects including depression, anxiety, and schizophrenia (404, 405). A side effect of dysbiosis (incorrect gut microorganisms) is that the gut becomes leaky i.e it passes larger molecules than would normally be the case. Thus peptides, which should normally be broken down to amino acids, leave the gut and enter the blood stream intact, where they are delivered to other organs. *Casein and Gluten*[8], proteins and mixture of proteins common in many foods break down to form very potent opio-peptides when acted on by certain pathogenic bacteria. These peptides have a narcotic action and act on opiate receptors in the brain, triggering major changes in brain function including depression, anxiety, schizophrenia, etc.(406, etc.) Certain pathogens more plentiful during dysbiosis also have been found to methylate mercury to its organic form which is more readily taken up by the blood and redistributed. Taking antibiotics is another cause of such dysbiosis.

Studies have shown a significant association between hypothyrodism and mood disorders such as depression (391, 8). Mercury from dental amalgam has been documented to cause hypothyroidism (50, 91, 212, 222, 369, 382, 390, 35ab). The majority of patients tested with hypothyroidism or thyroiditis and treated with dental amalgam replacement significantly improved after replacement (91, 369, 303).

Numerous studies have found long term chronic low doses of mercury cause neurological, memory, behavior, sleep, and mood problems (34, 69, 70, 71, 72, 74, 95, 107, 108, 109, 115, 119, 140, 141, 196, 199, 222, 252, 255, 257, 258, 282, 290, 303, 304]. Neurological effects have been documented at very low levels of exposure (urine Hg ¡ 4 μg/L), levels commonly received by those with amalgam fillings (290). One of the studies at a German University (199) assessed 20,000 people. There is also evidence that fetal or infant exposure causes delayed neurotoxicity evidenced in serious effect at middle age (255). Studies of groups of patients with amalgam fillings found significantly more neurological, memory, mood, and behavioral problems than the control groups. (34, 107, 108, 109, 140, 141, 196, 199, 222, 290]. Increased mercury levels from amalgam are documented to cause increased neurological problems related to lowered levels of neurotransmitters dopamine, serotonin, noreprenephrine, and acetylcholinesterase (35, 107, 140, 141, 175, 251, 254, 288, 290, 296, 305, 372, 451, 465, 412). The reduced neurotransmitter levels in those with amalgam appear to be a factor encouraging smoking since nicotine increases these neurotransmitter levels and a much higher

[8]**Internet:** "http://www.flcv.com/autismgc.html".

percentage of those with amalgam smoke than in those without amalgam (141).

Based on thousands of clinically followed cases by doctors, replacement of amalgam fillings resulted in the cure or significant improvement in the majority of cases for: depression (35, 94, 95, 107, 222, 271, 294, 212, 229, 230, 233, 303, 317, 320, 322, 376, 407), schizophrenia (294, 34, 35), insomnia (94, 95, 212, 222, 271, 304, 317, 322, 376, 407), anger (212, 233, 320, 407, 102), anxiety & mental confusion (94, 95, 212, 222, 229, 233, 271, 304, 317, 320, 322, 407, 57), memory disorders (94, 95, 222, 304, 407). For example, in a study of amalgam replacement for 56 persons who suffered from chronic depression, 16 had the condition eliminated and 34 had significant improvement after a year or 4 years (95).

One of the most common causes of depression and mood disorders has been documented to be past toxic exposures such as mercury or pesticides (585), and the majority treated for these at clinics that deal with such conditions have either recovered or shown significant improvement (600, 601, 552). Amalgam dental fillings have been found the most common source of such toxic exposures, with mercury thimerosal from vaccinations also affecting millions of children (600, 601). Many doctors treating depression and mood disorder conditions related to toxic exposures also usually recommend supplementing the deficient essential minerals that mercury affects by affecting cell membrane permeability and blocking cellular enzymatic processes, often obtaining a hair element test to determine imbalances and needs (560, 600). The body requires adequate, but not excessive, amounts of trace minerals and nutrients for proper functioning. Under certain conditions, excesses or deficiencies of many of these elements can set off symptoms of depression (560). Subnormal levels of zinc, for example, are associated with treatment resistant depression (561). And deficiencies of magnesium can provoke a wide range of psychiatric symptoms related to depression, ranging from apathy to psychosis (562). Research on manic patients, on the other hand, has revealed elevated vanadium in the hair–significantly higher levels than those measured in both a control group and a group of recovered manic patients (563).

1.5 The Danger of Vaccinations

Chronic over activation of the immune system has been found to be a major factor in neurological and cardiovascular conditions (593, 598, etc.) Immune adjuvants in vaccines including aluminum, mercury, special lipids, and even MSG in some cause activation of the immune system which can last for months. This causes inflammation of the brain that is magnified by each additional vaccination with more immune adjuvants. The high number of vaccinations in a short period of time has been found to be a major cause of autism spectrum and other inflammatory conditions in children, and also to be major factors in inflammatory conditions of older adults such as depression, Alzheimer's, Parkinson's, etc. (593, 598, 601, 600, etc.) Flu vaccinations in those over 55 years of age have been found to increase the risk of Alzheimer's by over 500%, along with increased risk of major depression (598).

1.6 Treatment of Depression

Anyone with depression should be examined and tested for toxic metal exposure or exposures to other toxics. Detoxification should be carried out as appropriate. Those with several amalgam fillings or metal crowns over amalgam are getting high exposures of extremely toxic substances that are highly inflammatory so should have the problematic dental work replaced. Everyone should also be checked for problematic root-canal teeth and jawbone cavitations, which likewise are highly inflammatory and can have major impacts on the immune system and health (605, 303). Reducing glutamate levels and blocking glutamate receptors can significantly improve depression (592, 593, 598).

Diet and lifestyle are important factors in preventing or controlling depression. One should avoid

alcohol, sugar, caffeine, and inflammatory substances such as MSG or aspartame, high-fructose corn syrup, fluoride, pesticides, aluminum in foods, mercury fillings, most vaccinations (esp. flu vax.), etc. (580, 594, 598). Stress causes increased stress hormones and inflammation, which can be major factors in depression and anxiety disorders.(594b) Reduce stress and get regular exercise. Yoga and meditation have been found to be helpful for many. Studies have found that dietary choices play a major role in psychological well being, so proper diet is important (594). Behavioral problems and *criminal behavior*[9] are correlated to toxic or excitotoxic exposures and diet choices (594b). Properly formulated nutritional supplements and diet modification have been found to be effective in treating ADHD, depression, and anxiety disorders (522, 20, 593, 594).

Studies and clinical experience have found that diet plays a role in depression and diet measures commonly avoid, cure, or significantly improve depression (565, 566, 580, 583, 591, 20). B Vitamins and magnesium deficiencies have been found to be factors in depression and anxiety. Supplementaion to assure proper levels is beneficial in treatment (565, 566, 583, 20). Many people, particularly women over 65, have B-12 deficiencies and respond dramatically to injections of the vitamin. But all B vitamins can boost mood; they work by facilitating neurotransmitter function. Other pluses: B vitamins are critical for preventing other maladies, including heart disease, cancer, and Alzheimer's. Suggested Dosage: Take at least 800 micrograms of folate, 1,000 mcg of B-12, and 25 to 50 milligrams of B-6. A B-complex vitamin should do the trick, says Hyman, and if you're depressed, take more. Take them in combination because otherwise one can mask another B vitamin deficiency (565).

The supplement 5-HTP has been shown by many studies and clinical experience to often be effective in treating or controlling depression (530, 20). Double blind studies have found 5-HTP to be as effective as SSRIs and other types of antidepressives at treating depression. Tryptophan likewise has been found beneficial in some with depression (495). But studies have also cast doubt on serotonin levels as the main cause in depression and found both 5-HTP and SSRIs have limited effect on many with depression. SSRIs appear to be attempting to suppress symptoms related to one type of imbalance found in many with depression rather than the underlying causes.

SAMe (400-1600 mg) and Inositol have been found to be effective in treating depression and anxiety with effectiveness at least as much as pharmaceutical antidepressants and much less adverse effects (565, 566, 580, 590, 20). SAMe is an amino acid combination produced by humans, animals, and plants. Supplements come from a synthetic version produced in a lab that has shown a lot of promise in European studies. May affect the synthesis of neurotransmitters. Has fewer side effects than 5-HTP and fewer drug interactions than Saint-John's-wort. Dosage: Can range from 400 to 1, 200 mg a day, though high doses can cause jitteriness and insomnia. Risks: People with bipolar disorder shouldn't use it without supervision because it can trigger mania. (566) Inositol has been found to be effective for treating OCD, panic disorders, and bipolar depression (591), with effectiveness at least as much as SSRIs and less adverse effects (591). St. Johns Wort (300 mg x 3) also has been found effective for many (565, 580, 20) and is one of the best-known remedies. Best for mild to moderate depression. Suggested Dosage (566): Start on a dose of 300 mg (standardized to 0.3 percent hypericin extract) two to three times a day, depending on severity of depression; it can take three weeks to show benefits. Risks: It may interfere with up to half of all drugs, prescription and over-the-counter.

Amino acids are the building blocks of neurotransmitters; **5-HTP** is the most popular. Taking it can elevate mood in cases of depression, anxiety, and panic attacks, and relieve insomnia. Increases production of the neurotransmitter serotonin. Suggested Dosage (566): Start with a low dose, 50 mg two to three times a day; after two weeks, increase the dose to 100 mg three times a day. Risks: Mild nausea or diarrhea. Before starting, get off antidepressants (under a doctor's supervision); the combination can produce an overload of serotonin. Tyrosine is another amino acid found to often be useful in overcoming depression (20).

[9]**Internet:** "http://www.flcv.com/violence.html".

Lower levels of fish oil (EPA) has been found to be significantly related to depression. (20) Elderly people have been found to be of special risk regarding depression. Studies have found higher levels of EPA to be associated with lower likelihood of depression or dementia (580b) in the elderly. Theoflavins from black or green tea and curcumin (turmeric) have also been found to be significantly effective against inflammation, which is a major factor in depression (580). Poor digestion results in poor mineral and nutrient absorption and is a factor in many chronic conditions. Digestive problems often increase with aging, due to reductions in digestive enzyme production and availability as well as increased proliferation of pathogenic organisms. Supplementation with digestive enzymes and probiotics often significantly improves digestion and improves digestive related conditions (580).

Adrenal fatigue and long-term increased stress hormones such as cortisol have been found to be common factors in depressive disorders (20). Prescription hydrocortisone can help in the short term, but supplements found to often help adrenal fatigue include, licorice extract, Panax ginseng, DHEA, Rhodiola, pantehine, and Eleuthero (20). Exercise routines found to be helpful with depressive disorders include walking, yoga, and pilates (20). Deep breathing exercises and meditation have also been found to be beneficial in alleviation of depressive disorders (20).

Hypothyroidism is also often a factor in depressive conditions, and treatments such as mercury detoxification and supplements such as iodine, zinc, copper, selenium, tyrosine, vitamins C, E, B12, and Ashwagandha extract are often helpful when this is a factor (20).

Birth control pills and artificial hormone replacement drugs can deplete nutrients such as vitamin B6 and create estrogen/progestin imbalances, which can be a factor in depression. Supplementing with Vitamin C, multivitamin B complex, magnesium, iodine, and tyrosine have been found to be helpful in this situation (20).

Essential fatty acids (EPA/DHA) benefits are among the best documented. (20, 21, 22) The reason they're so effective is EFAs are part of every cell membrane, and if those membranes aren't functioning well, then neither is your brain. Suggested Dosage (566): For depression, take at least 2,000 to 4,000 mg of fish oil a day. Should be purified or distilled so it's free of heavy metals. Risks: Very safe, albeit unstable. Since it can oxidize in your body, take it along with other antioxidants, like natural vitamin E (400 IUs a day).

DHEA is a hormone marketed in Europe specifically for postmenopausal depression, though it may be helpful for other forms as well. It has been used in conjunction with estrogen to treat hot flashes. Suggested Dosage (566): 10 to 200 mg a day. Risks: Any hormonal supplement not properly monitored has the potential to increase cancer risk.

Rhodiola rosea is considered an adaptogen, which means it can increase your resistance to a variety of stressors. It may be good for mild to moderately depressed patients (20). Suggested Dosage (566): Take 100 to 200 mg three times a day, standardized to 3 percent rosavin. Risks: More than 1, 500 mg a day can cause irritability or insomnia.

Other nutrients found to cause depression when low or to usually be low in depression or to be effective additions in treating depression include ginkgo biloba, DHEA, natural progesterone, pregnenolone, DMAE, L-Carnitine, NADH, Phenylalanine, Folic Acid, Vit B12 (cobalamine), B6, other B vitamins, choline, vit D, vit C, potassium, testosterone in men over 40 (580, 582, 565, 566). A product that contains several of these nutrients is Happiness 1-2-3 (vit B complex, magnesium, St.Johns Wort, L-Theanine, 5-HTP, magnolia) (583). Other companies referenced here have similar combinations (580, 582).

1.7 Anxiety Disorders include Panic Disorder, OCD, PTSD, Phobias, and General Anxiety Disorder

(584) As previously noted, anxiety or panic disorder can be related to not acknowledging or burying feelings (583). Panic disorder is characterized by repeated episodes of intense fear. Affects 3 to 6 million. Obsessive-Compulsive Disorder (OCD) is characterized by anxious thoughts and uncontrollable ritualistic behavior. Affects 2% of the population. Some studies have suggested OCD patients usually have high glutamate levels, which overexcites areas of the brain (581). Post-Traumatic Stress Disorder (PTSD) is a debilitating illness resulting from a traumatic event or events. It affects a large number of people. Phobias are irrational fears of things or situations. Affects over 10% of the population. Generalized Anxiety Disorder (GAD) is chronic, daily worrying about health, finances, work, family, etc. Stress is a psychological and physical response to the demands of daily life that exceed the person's ability to cope successfully. Stress can have physical effects prolonged stress can have debilitating effects. Two conventional non-pharmaceutical treatments for anxiety are behavioral therapy (breathing techniques, exposure therapy, etc.) and cognitive therapy (modification of thinking patterns).

As previously note, environmental toxins can be a factor in causing nutritional deficiencies, imbalances, and inflammation related to anxiety disorders and reductions in exposures have been found to be beneficial. Hypoglycemia may be a factor in some anxiety disorders - eat more frequent small quantities including protein, nuts, etc. Many are adversely affected by stimulants such as caffeine. Irregular or insufficient sleep patterns can be a significant factor. Regular exercise is generally beneficial in anxiety disorders. Massage therapy, including aromatherapy is often helpful, along with meditation and deep breathing exercises. Music, yoga, muscle relaxation techniques, biofeedback, etc. are also often helpful.

Deficiency of B vitamins and magnesium have been found to be common factors in anxiety disorders. (583). Adapton (fish oil) is commonly used helpful treatment for anxiety in Europe. (580) Very successful for fatigue, etc. Theanine (green tea extract) - calming and lowers blood pressure. (580, 582, 583)

Ginseng has been found effective for many post-menapausal women's anxiety, fatigue, depression. Reishi has helped some and Ashwagunda (Indian Ginseng). (580) A product with several of these nutrients is Calming Balance (vit B complex, magnesium, L-Theanine, Magnolia extract). (583). The other sources referenced here have similar products (580, 582).

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NOTE: all references not included here can be found in (600). You can find abstracts of the medical studies at the National Library of Medicine. National Institute of Health (Medline) and obtain the papers there. (http://www.nlm.nih.gov/)

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Mercury impairs alfa-1-adrenergic receptors, astrocytic dopamine uptake, and serotonergic 5-HT2 receptor. The last one is stimulated by cocaine and LSD, so at least those drugs may be abused more due to mercury. We can remember that PhD Alfred Stock, leading early century mercury/chelator chemist stated that only cocaine was able to reverse his mental impairments form mercury, which as a chemist was easily available, and it was also legal at the time yet, in the early century.

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Many of my patients reported the lifting of depression, anxiety, moodiness within a very short time of the total mercury decontamination of their mouths. I do not know the mechanism for that, and I am reporting this point so that those able to study the link between psychiatric illness and mercury would tell me one day what the mechanism is. The question here is that mercury, though out of the mouth, is not out of the brain in such a short time (two wks.) so, could these psychiatric illnesses be caused by the galvanic currents alone? I do not know.

Virtually 100% of the dozens of patients I've had suffering depression improve within 2 wks. One patient, who was depressed before amalgam removal, told me today that shw now has a positive attitude to life that she did not have before, and that she feels like a child!

Kindest regards. Hesham. DDS

Hesham El-Essawy [pop@EL-ESSAWY.COM]

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(This was was mostly snipped from a much larger paper (600) with over 3000 medical study references regarding common toxic exposures to mercury that are affecting large numbers of people with neurological effects)