TEST REPORT

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ZRT LABORATORY

 # D2026 05 04 210 U

Ordering Provider:
Getuwell

Samples Received
05/04/2026

Report Date
05/19/2026

Samples Collected
Urine - 04/18/26 08:00
Urine - 04/18/26 10:15
Urine - 04/18/26 21:15
Urine - 04/18/26 23:10

Patient Name: Dried Urine LCMS Neurotransmitters and Diurnal Hormones II
Patient Phone Number:

Gender	Last Menses	Height	Waist
Female	03/29/2026	5 ft 6 in	Unspecified
DOB	**Menses Status**	**Weight**	**BMI**
1/1/2005 (21 yrs)	Pre-Menopausal	130 lb	21.0

TEST NAME	RESULTS | 04/18/26	RANGE
Urinary Inhibitory Neurotransmitters		
Tryptophan	4028	2633-12688 µg/g Cr (Optimal 3970-8450)
Serotonin	75.3	47.6-140.3 µg/g Cr (Optimal 61.0-103.2)
5-HIAA	4376	2205-11816 µg/g Cr (Optimal 2988-5850)
GABA	112 L	167-463 µg/g Cr (Optimal 193-367)
Glycine	66	41-295 mg/g Cr (Optimal 61-159)
Taurine	242.6	7.1-293.1 mg/g Cr (Optimal 24.5-134.1)
Urinary Excitatory Neurotransmitters		
Glutamate	998 L	1213-4246 µg/g Cr (Optimal 1515-2710)
Glutamine	38	27-106 mg/g Cr (Optimal 37-71)
Histidine	34.2	10.8-98.9 mg/g Cr (Optimal 19.7-58.4)
Histamine	11.6	3.6-44.3 µg/g Cr (Optimal 5.2-15.3)
N-Methylhistamine	109	59-195 µg/g Cr (Optimal 79-140)
PEA	7.1	3.6-38.8 µg/g Cr (Optimal 5.3-16.1)
Tyrosine	3922	3128-15548 µg/g Cr (Optimal 4790-10278)
Tyramine	373	187-910 µg/g Cr (Optimal 279-588)
Dopamine	162	103-282 µg/g Cr (Optimal 144-240)
DOPAC	992	495-2456 µg/g Cr (Optimal 658-1449)
HVA	5198	3025-9654 µg/g Cr (Optimal 3737-7048)

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TEST NAME	RESULTS | 04/18/26	RANGE
Urinary Excitatory Neurotransmitters		
Norepinephrine (pooled)	14.8	10.0-35.7 µg/g Cr (Optimal 15.0-28.1)
Normetanephrine	14.7	13.4-44.8 µg/g Cr (Optimal 17.9-31.7)
Epinephrine (pooled)	1.7	0.8-6.2 µg/g Cr (Optimal 1.4-4.2)
Ratio: Norepi/Epi	8.7	2.9-25.2 (Optimal 5.2-13.7)
VMA	2831	1996-5939 µg/g Cr (Optimal 2580-4766)
Urinary Inflammatory Markers		
Kynurenine	211	108-1641 µg/g Cr (Optimal 257-960)
Kynurenic Acid	480	437-1719 µg/g Cr (Optimal 639-1200)
3-Hydroxykynurenine	235	80-822 µg/g Cr (Optimal 147-467)
Xanthurenic Acid	1002	450-2175 µg/g Cr (Optimal 694-1510)
Urinary Free Diurnal Cortisol		
Free Cortisol	17.37	7.8-29.5 µg/g Cr (1st Morning)
Free Cortisol	47.68	23.4-68.9 µg/g Cr (2nd Morning)
Free Cortisol	8.11	6.0-19.2 µg/g Cr (Evening)
Free Cortisol	1.78 L	2.6-8.4 µg/g Cr (Night)
Urinary Free Diurnal Cortisone		
Free Cortisone	27.84 L	31.6-91.6 µg/g Cr (1st Morning)
Free Cortisone	69.96	63.3-175.8 µg/g Cr (2nd Morning)
Free Cortisone	25.83 L	30.6-88.5 µg/g Cr (Evening)
Free Cortisone	7.18 L	15.5-44.7 µg/g Cr (Night)
Urinary Diurnal Melatonin MT6s		
Melatonin	74.46 H	18.0 - 40.9 µg/g Cr (1st Morning)
Melatonin	27.23	7.3 - 31.9 µg/g Cr (2nd Morning)
Melatonin	1.09	0.7 - 2.2 µg/g Cr (Evening)
Melatonin	13.35 H	1.7 - 11.1 µg/g Cr (Night)
Urinary Diurnal Norepinephrine		
Norepinephrine	11.22	9.4-22.0 µg/g Cr (1st Morning)
Norepinephrine	23.31	12.6-38.2 µg/g Cr (2nd Morning)

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TEST NAME	RESULTS | 04/18/26	RANGE
Urinary Diurnal Norepinephrine		
Norepinephrine	20.48 L	21.1-42.9 µg/g Cr (Evening)
Norepinephrine	41.25 H	16.9-38.8 µg/g Cr (Night)
Urinary Diurnal Epinephrine		
Epinephrine	0.70	0.5-1.5 µg/g Cr (1st Morning)
Epinephrine	2.31	0.7-6.1 µg/g Cr (2nd Morning)
Epinephrine	6.05	2.3-8.1 µg/g Cr (Evening)
Epinephrine	1.35	1.2-4.2 µg/g Cr (Night)
Urinary Creatinine		
Creatinine (pooled)	1.31	0.3-2.0 mg/mL
Creatinine	1.13	0.3-2.0 mg/mL (1st morning)
Creatinine	2.13 H	0.3-2.0 mg/mL (2nd morning)
Creatinine	1.68	0.3-2.0 mg/mL (Evening)
Creatinine	1.61	0.3-2.0 mg/mL (Night)

<dl *= Less than the detectable limit of the lab.* ***N/A*** *= Not applicable; 1 or more values used in this calculation is less than the detectable limit.* ***H*** *= High.* ***L*** *= Low.*

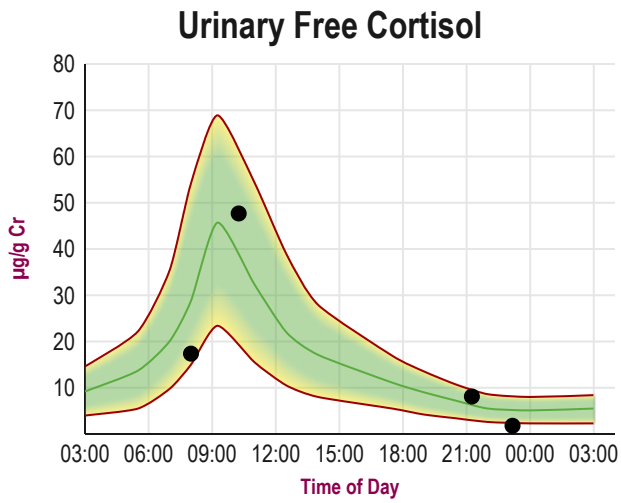
Therapies

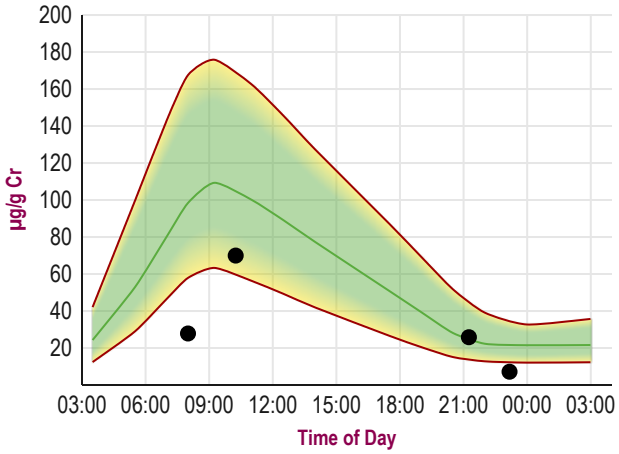
Probiotics; oral Vitamin D3 (OTC) (12 Hours Last Used)

Graphs

Disclaimer: Graphs below represent averages for healthy individuals not using hormones. Supplementation ranges may be higher. Please see supplementation ranges and lab comments if results are higher or lower than expected.

Average ▼▲ Off Graph





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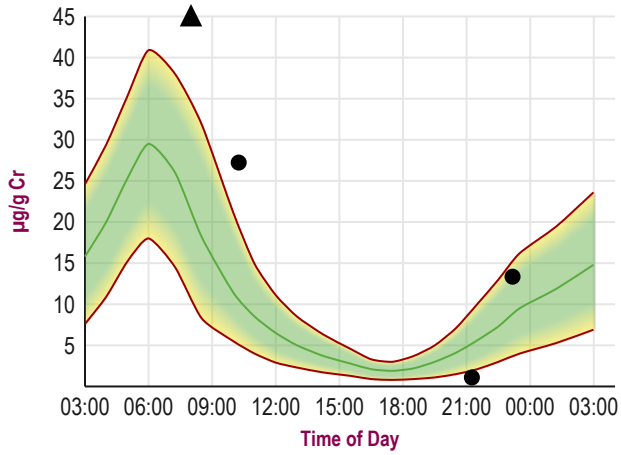
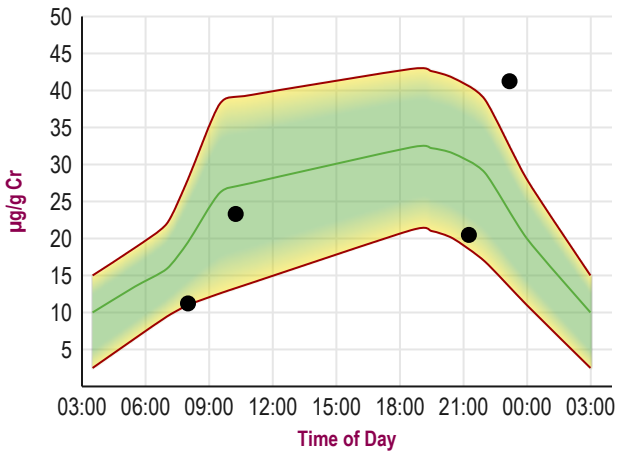
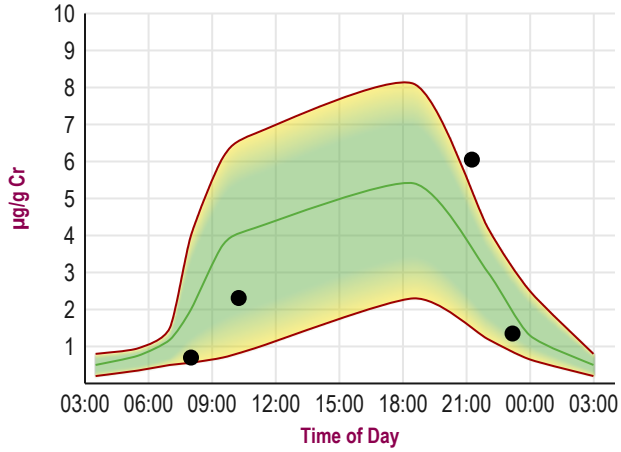
Urinary Melatonin (MT6s)



Urinary Norepinephrine



Urinary Epinephrine



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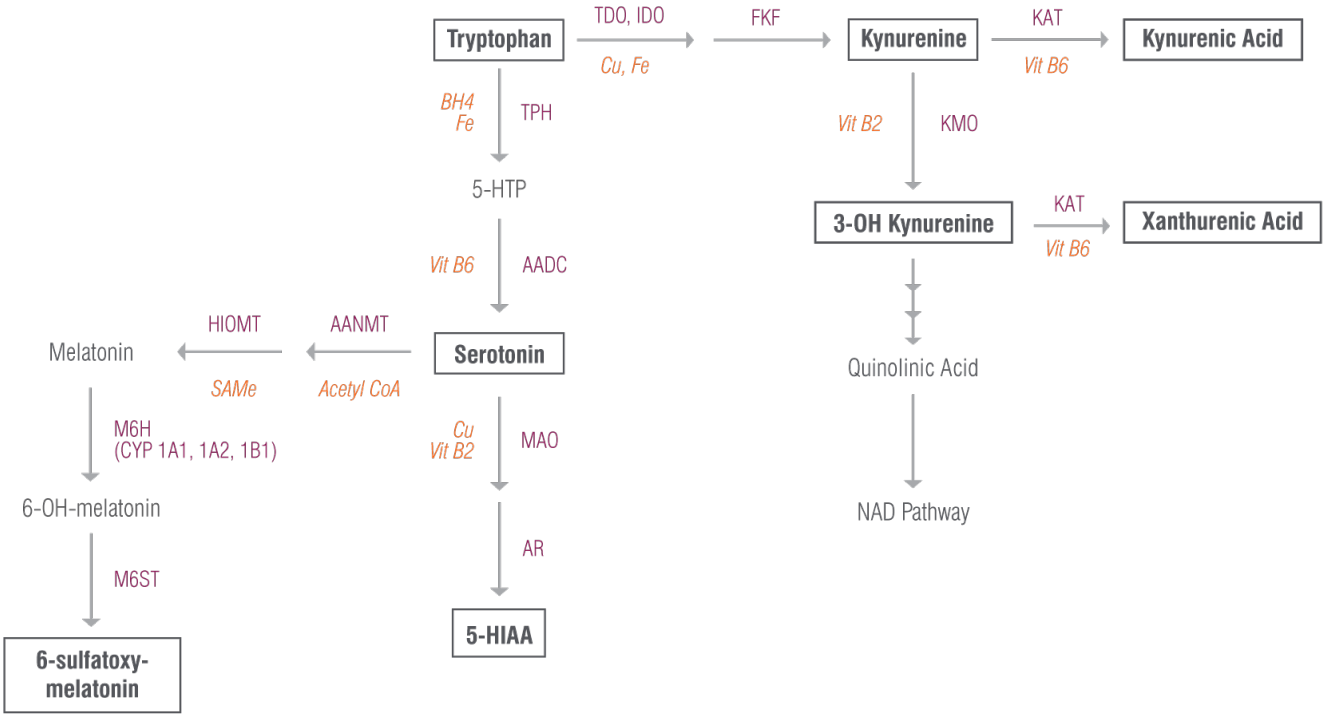
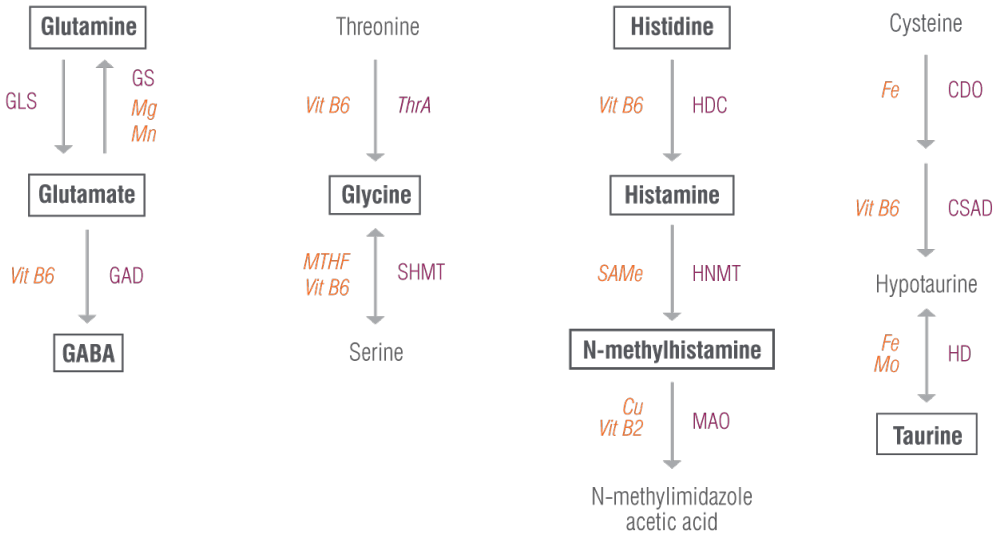
Neurotransmitter Cascades

Tryptophan & Metabolites



Glutamate/GABA, Glycine, Histamine & Taurine



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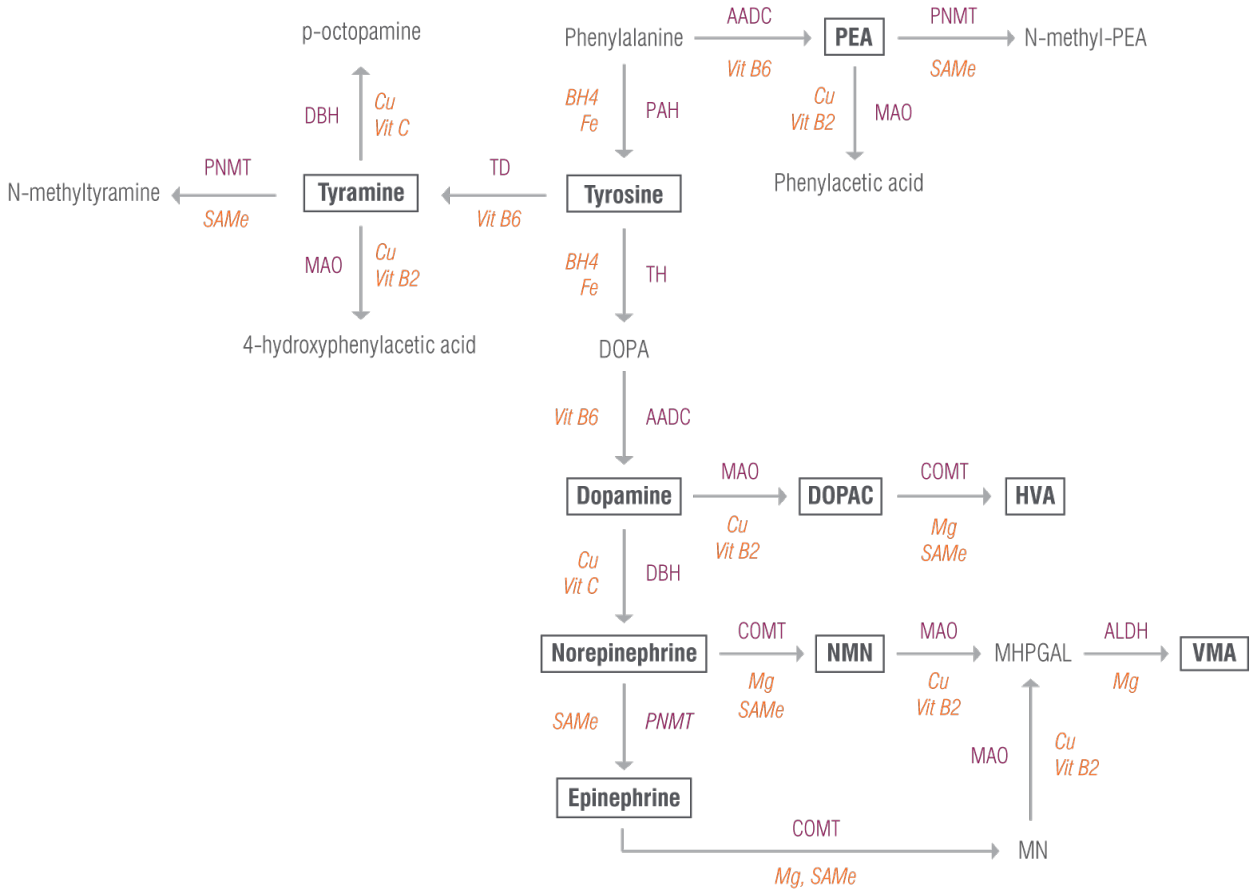
Catecholamines & Metabolites



Abbreviations & Key

Neurotransmitters & Metabolites:	HVA	homovanillic acid
	NMN	normetanephrine
	PEA	phenethylamine
	VMA	vanillylmandelic acid
	5-HIAA	5-hydroxyindole 3-acetic acid

Cofactors:	BH4	tetrahydrobiopterin
	Cu	copper
	Fe	iron
	Mg	magnesium
	Mn	manganese
	Mo	molybdenum
	MTHF	methyltetrahydrofolate
	SAMe	S-adenosyl methionine

Enzymes:	AADC	aromatic L-amino acid decarboxylase
	AANMT	arylalkylamine N-methyltransferase
	ALDH	aldehyde dehydrogenase
	AR	aldehyde reductase
	CDO	cysteine dioxygenase
	COMT	catechol-O-methyltransferase
	CSAD	cysteinesulfinic acid decarboxylase
	DBH	dopamine beta hydroxylase
	FKF	N-Formyl kynurenine formamidase
	GAD	glutamate decarboxylase
	GLS	glutaminase
	GS	glutamine synthetase
	HD	hypotaurine dehydrogenase
	HDC	histidine decarboxylase
	HIOMT	hydroxyindole-O-methyltransferase
	HNMT	histamine N-methyltransferase
	IDO	indoleamine 2,3-dioxygenase
	KAT	kynurenine aminotransferase
	KMO	kynurenine hydroxylase/monooxygenase
	MAO	monoamine oxidase
	M6H	melatonin 6 hydroxylase
	M6ST	melatonin 6 sulfotransferase
	PAH	phenylalanine hydroxylase
	PNMT	phenylethanolamine N-methyltransferase
	SHMT	serine hydroxymethyltransferase
	TD	tyrosine decarboxylase
	TDO	tryptophan 2,3-dioxygenase
	TH	tyrosine hydroxylase
	ThrA	threonine aldolase
	TPH	tryptophan hydroxylase

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Disclaimer: Symptom Categories below show percent of symptoms self-reported by the patient compared to total available symptoms for each category. For detailed information on category breakdowns, go to www.zrtlab.com/patient-symptoms.

SYMPTOM CATEGORIES	RESULTS | 04/18/26
Estrogen / Progesterone Deficiency	25%
Estrogen Dominance / Progesterone Deficiency	16%
Low Androgens (DHEA/Testosterone)	33%
High Androgens (DHEA/Testosterone)	2%
Low Cortisol	17%
High Cortisol	26%
Hypometabolism	17%
Metabolic Syndrome	2%

SYMPTOM CHECKLIST	MILD	MODERATE	SEVERE
Aches and Pains			
Acne			
ADD/ADHD			
Addictive Behaviors			
Allergies			
Anxious			
Autism Spectrum Disorder			
Bleeding Changes			
Blood Pressure High			
Blood Pressure Low			
Blood Sugar Low			
Body Temperature Cold			
Bone Loss			
Breast Cancer			
Breasts - Fibrocystic			
Breasts - Tender			
Chemical Sensitivity			
Cholesterol High			
Constipation			
Depressed			
Developmental Delays			
Eating Disorders			
Fatigue - Evening			
Fatigue - Morning			
Fibromyalgia			
Foggy Thinking			
Goiter			
Hair - Dry or Brittle			
Hair - Increased Facial or Body			
Hair - Scalp Loss			
Headaches			
Hearing Loss			
Heart Palpitations			
Hoarseness			
Hot Flashes			
Incontinence			
Infertility			
Irritable			
Libido Decreased			
Mania			

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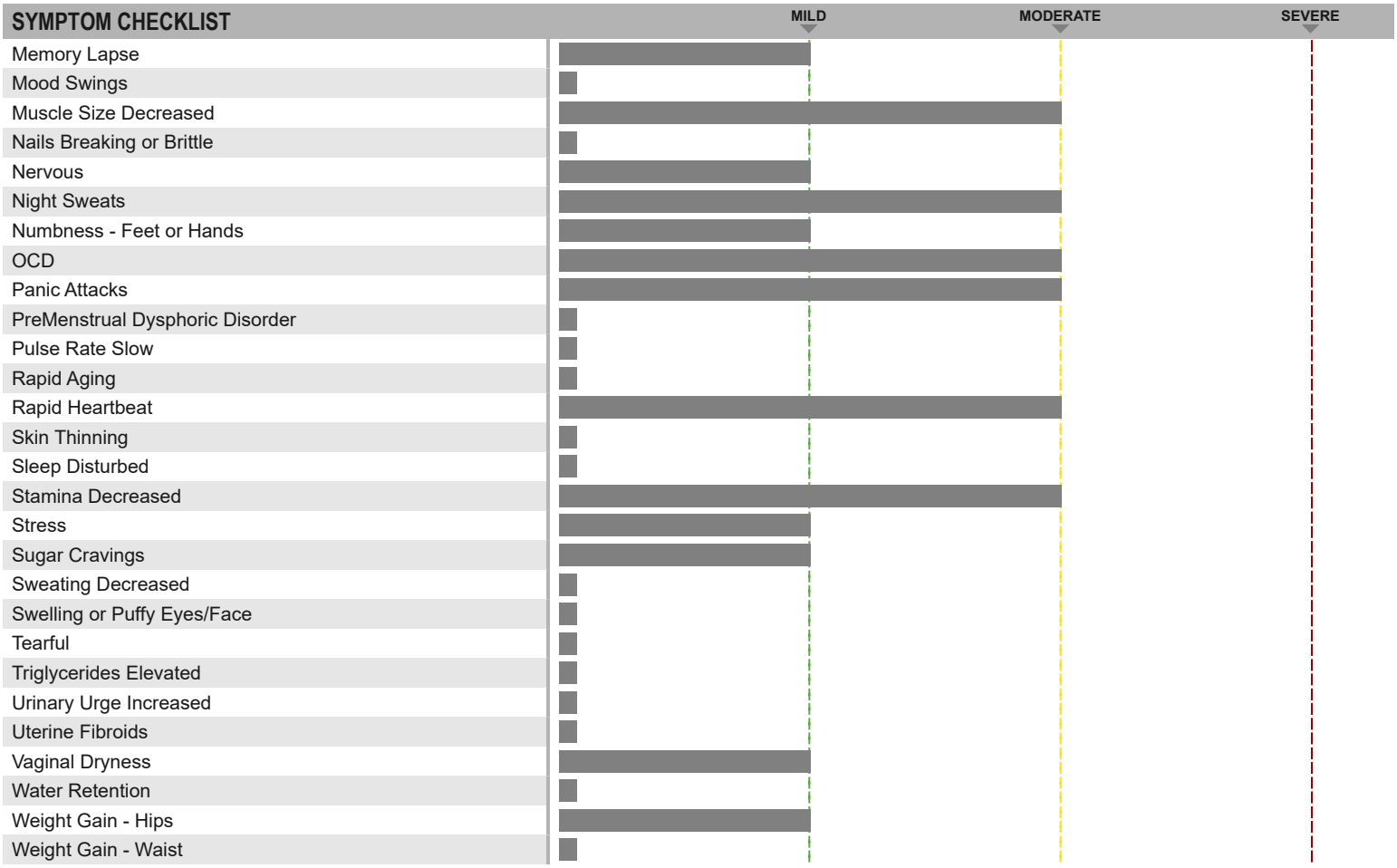

Lab Comments

INHIBITORY NEUROTRANSMITTERS

TRYPTOPHAN
Tryptophan is low-normal (<20th percentile). The essential amino acid tryptophan originates in diet and serves as a constituent of proteins and a precursor to neurotransmitters. Only a fraction of tryptophan is used by the GI tract, the vast majority of this amino acid enters portal circulation and undergoes liver metabolism. The remaining tryptophan pool, together with its liver degradation products, is distributed to peripheral circulation and transported to tissues such as the brain, heart, and skeletal muscle. Tryptophan not taken up by the upper GI tract is metabolized by resident microbiota.
Tryptophan is a substrate for two important biosynthetic pathways relevant to the inflammatory neuropsychiatric interface: the generation of the neurotransmitter serotonin and therefore hormone melatonin, and the formation of kynurenine derivatives and therefore niacin (vitamin B3). Tryptophan hydroxylase initiates the two-step conversion to serotonin, a process that requires tetrahydrobiopterin (BH4), iron and vitamin B6. Approximately 5-10% of tryptophan is converted to serotonin. Tryptophan dioxygenase and indoleamine 2,3-dioxygenase are the enzymes responsible for tryptophan's conversion to kynurenine in a copper and iron-dependent manner. In fact, upward of 90-95% of tryptophan is metabolized to the kynurenine pathway, and upregulation of this pathway may be a hallmark of neuroinflammation.
Research shows that tryptophan excretion is low in patients with autism spectrum disorder (Kaluzna-Czaplinska, Michalska et al. 2010), and in some individuals with a low protein diet (Poesen, Mutsaers et al. 2015). Clinically, low tryptophan is associated with aggression (Comai, Bertazzo et al. 2016), depression (Maes, Wauters et al. 1996, Messaoud, Mensi et al. 2019), impulsivity (Walderhaug, Lunde et al. 2002), with fructose malabsorption (Ledochowski, Widner et al. 2001), Alzheimer's disease (Gulaj, Pawlak et al. 2010), Crohn's disease (Gupta, Thaker et al. 2012), multiple sclerosis (Monaco, Fumero et al. 1979), pain disorders like fibromyalgia (Yunus, Dailey et al. 1992), and glucose imbalance like diabetes (Herrera, Manjarrez et al. 2003).

TREATMENT CONSIDERATIONS: Increasing protein intake may help increase tryptophan to a normal range. High tryptophan foods include chocolate, meat, tofu, fish, beans, milk, nuts, seeds, oatmeal, and eggs. The recommended daily intake for tryptophan is 4 mg per kilogram of body weight or 1.8 mg per pound.

SEROTONIN
Serotonin is within reference range. Serotonin has calming effects and contributes to the feelings of well-being. Serotonin elevates mood,

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decreases anxiety, appetite, and libido, improves sleep and memory, eases depression, and helps regulate body temperature. Most of serotonin in the human body is produced in the gastrointestinal tract, where it stimulates gut motility.

5-HIAA
5-hydroxyindoleacetic acid (5-HIAA) is within reference range. 5-HIAA is the primary metabolite of serotonin via the actions of monoamine oxidase and aldehyde dehydrogenase enzymes.

GABA
GABA is below the optimal range. The brain's major inhibitory neurotransmitter, GABA functions as the "off" switch in the brain. GABA is essential to limiting brain neuron excitation so that input signals are balanced and not overdone. Appropriate levels of GABA prevent anxiety, improve mood, promote sleep, lower blood pressure, act as a muscle relaxant, aid in formation and storage of fear memories, increase insulin secretion and decrease blood glucose levels.

Research on urinary levels of GABA is scarce, however in individuals with anxiety, GABA levels are low in the blood, in cerebrospinal fluid and in the brain (Mann, et. al. 2014). The inhibitory and excitatory balance between GABA and glutamate is very important for healthy brain function, and imbalance in these systems may contribute, in part, to the pathology of anxiety, but we have yet to understand the mechanism.

THERAPEUTIC CONSIDERATIONS: with low GABA, supplementation with GABA, L-theanine, cofactor support (e.g. B6), growth hormone-releasing hormone, Ginko biloba, Ashwagandha, Kava, Valerian root, Melissa off. (lemon balm), Scutellaria sinensis (skullcap), Gotu Cola, Magnolia and Phellodendron bark, and probiotics may be helpful (Alramadhan et al., 2012; Awad et al., 2007; Alexeev et al., 2012; Dhakal et al., 2012). Additionally, yoga (Streeter et al., 2012) and meditation (Guglietti et al., 2013) increase brain GABA levels.

GLYCINE
Glycine is within normal range. Glycine is a simple, nonessential (can be made in the body) amino acid that plays a role in the production of DNA, phospholipids, collagen, creatine, heme and glutathione. Glycine serves as a neurotransmitter that modulates excitatory signals in the brain, and as an anti-inflammatory agent that calms aggression, improves sleep quality, stabilizes blood sugar, and improves metabolic parameters.

TAURINE
Taurine is high-normal (>80th percentile), likely due to supplementation or recent dietary intake. Taurine is a semi-essential or conditionally essential sulfur-containing amino acid and an inhibitory (calming) neurotransmitter. Taurine improves sleep, relieves anxiety, alleviates fatigue, aids with metabolism and digestion, and promotes glucose control and electrolyte balance.
The main source of taurine is diet (highest in shellfish and dark meat of poultry). Taurine protects healthy cells and tissues, functions as a potent antioxidant to reduce oxidative stress, mitigates mitochondrial and endoplasmic reticulum stress, inhibits lipid peroxidation, improves energy metabolism, regulates gene expression, and participates in detoxification, calcium homeostasis and osmoregulation processes. By fulfilling all these functions, taurine is therefore protective in cardiovascular health, improves lean body mass and exercise performance. With regard to brain health, taurine serves a neuroprotective role, promotes neural development in embryonic and adult brain tissues, and is an important factor in neurogenesis.
Research shows that taurine excretion is high with taurine supplementation (taurine is an ingredient in many "energy drinks") (Gao, Bae et al. 2019), with high protein diet (Turner, Brum et al. 1964), after intense exercise (Cuisinier, Ward et al. 2001), in alcoholism (Turner, Brum et al. 1964), with adrenal steroid therapy (Turner, Brum et al. 1964), and in non-invasive bladder cancer (Srivastava, Roy et al. 2010). High taurine levels are implicated in autism spectrum disorder (Moreno-Fuenmayor, Borjas et al. 1996), depression (Altamura, Maes et al. 1995) and HIV (Hortin, Landt et al. 1994).

THERAPEUTIC CONSIDERATIONS: no therapy is necessary, but evaluation of the source of taurine is warranted.

EXCITATORY NEUROTRANSMITTERS

GLUTAMATE
Glutamate is lower than the reference range. The brain's major excitatory neurotransmitter glutamate (also known as glutamic acid) functions as the "on" switch in the brain. Glutamate regulates appetite, thinking (cognition), increases gut motility, optimizes learning, modulates memory, improves libido, and decreases sleep. Low urinary glutamate levels have been reported in patients with migraines (Ragginer et al., 2012). Clinically, low glutamate levels are implicated in the causes of agitation, depression, chronic fatigue, lack of concentration, low energy levels, and sleep difficulties.

THERAPEUTIC CONSIDERATIONS: L-glutamine may be beneficial to restore glutamate to normal values.

GLUTAMINE
Glutamine is low-normal (<20th percentile). Glutamine is an essential and the most abundant free amino acid in the human body. Glutamine provides fuel for rapidly dividing cells (lymphocytes, enterocytes and epithelial cells of the intestines), helps balance ammonia levels in the body, improves immune system function, contributes to biosynthesis of proteins, amino acids, nucleic acids and glutathione, and protects intestinal lining. Additionally, glutamine increases glutamate and GABA levels in the brain and in the body.
Although the body usually makes enough glutamine to meet all its needs, extreme stress (e.g., strenuous exercise, persistent stress, or injury) can increase the demand for glutamine beyond the amount naturally manufactured. Research on urinary low glutamine levels is scarce,

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however low circulating glutamine levels are reported after intense exercise (Keast, Arstein et al. 1995), in overtraining syndrome (Rowbottom, Keast et al. 1996), in diabetes (Liu, Zheng et al. 2019), depression (Umehara, Numata et al. 2017), and in autism spectrum disorder (Rolf, Haarmann et al. 1993, Moreno-Fuenmayor, Borjas et al. 1996). Low glutamine levels are associated with high oxidative stress (Pietzner, Kaul et al. 2017).

THERAPEUTIC CONSIDERATIONS: consider supplementation with glutamine which comes in capsules or powder. Glutamine is a fairly bland tasting amino acid and easily goes into smoothies. Glutamine is also high in chicken, fish, cabbage, spinach, diary, tofu and lentils among many over foods.

HISTIDINE
Histidine is within range. Histidine is a semi-essential amino acid that gives rise to the neurotransmitter histamine. Histidine protects neurons, assists with making new blood cells, reduces inflammation and oxidative stress, helps with tissue repair and growth. Histidine also helps ameliorate fatigue, promotes clear thinking and concentration, reduces appetite, decreases anxiety, improves sleep and glucose homeostasis.

HISTAMINE
Histamine is within reference range. Histamine plays a dual role in the body as a neurotransmitter and a modulator of the immune system. Histamine has anti-pain properties, plays a neuroprotective role in the brain, and contributes to optimal maintenance of cognition and memory. Histamine stimulates wakefulness and decreases sleep, stimulates gastric acid production, increases metabolism, suppresses appetite, and prevents weight gain. Histamine is a potent vasodilator and a pro-inflammatory agent.

N-METHYLHISTAMINE
N-Methylhistamine is within range. N-Methylhistamine is a major metabolite of the neurotransmitter histamine.

PEA
PEA is within reference range. PEA, also known as phenethylamine, promotes energy, elevates mood, and regulates attention. PEA also contributes to aggression, serves as a biomarker for ADHD, and prolongs the signaling of dopamine, norepinephrine, and serotonin.

TYROSINE
Tyrosine is low-normal (<20th percentile). Tyrosine is obtained from the diet (sesame seeds, cheese, soy, meat, nuts, and fish) or synthesized in the body from the amino acid phenylalanine. Tyrosine serves as a constituent of proteins and gives rise to neurotransmitters, like dopamine, norepinephrine and epinephrine; and the trace-amine tyramine. Additionally, in the thyroid gland, tyrosine is complexed with iodine to create thyroid hormones. Tyrosine enhances cognitive performance, energy and alertness, and improves memory after sleep deprivation, therefore fatigue and poor memory along with low thyroid symptoms may be noted in patients with low tyrosine levels. Tyrosine also prevents the depletion of central and peripheral catecholamines (dopamine, norepinephrine, epinephrine) induced by acute stress, thereby eliciting protective effects on behavioral and cardiovascular parameters in the body.
Research shows that tyrosine is low in depression (Zheng, Chen et al. 2016), in post-stroke depression (Xie, Han et al. 2020), and in in chronic kidney disease (Molnar, Wagner et al. 2005).

THERAPEUTIC CONSIDERATIONS: consider increasing dietary tyrosine from cheese, beans, meat, nuts, eggs, and whole grains. Tyrosine is available as a supplement with common dosages of 500-3000 mg per day in divided dosages.

TYRAMINE
Tyramine is within range. Tyramine is a trace amine derived from the amino acid tyrosine that is found naturally in food. Specifically, tyramine is found in aged, fermented cured or spoiled food where microbes with decarboxylase enzymes convert tyrosine to tyramine. These foods include aged cheeses, smoked fish, cured meats, wine, and some types of beer. In sensitive individuals, eating high amount of tyramine can trigger migraines and increase blood pressure.

DOPAMINE
Dopamine is within reference range. Dopamine improves attention, focus, and motivation, helps with decision making, modulates movement control, promotes lactation, increases blood pressure, urine output and sodium excretion, and allows for feelings of reward and pleasure. Additionally, dopamine plays a central role in the etiology of addiction. Dopamine also serves as the parent precursor to norepinephrine and epinephrine.

DOPAC
DOPAC is within reference range. DOPAC is the primary metabolite of dopamine formed via the actions of monoamine oxidase.

HVA
Homovanillic acid (HVA) is within reference range. HVA is a dopamine metabolite.

NOREPINEPHRINE
Norepinephrine is low-normal (<20th percentile). Norepinephrine functions both as a neurotransmitter and a hormone, participating in the body's "fight or flight" response. Norepinephrine increases alertness, focuses attention, fine-tunes vigilance, increases blood pressure, heart rate, and blood glucose, reduces digestive activity, pain and sleep, prevents bladder emptying, and regulates body temperature. The adrenal gland produces approximately 20% of norepinephrine with 80% produced by the sympathetic nerve fibers. Research shows that urinary

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norepinephrine is reduced in patients with Alzheimer's disease. Clinically, low norepinephrine is implicated in anorexia, attention impairment, depression, fatigue, low blood pressure, lack of motivation, lethargy, low mood, memory issues, slow pulse rate, and weight issues.

THERAPEUTIC CONSIDERATIONS: Precursor supplementation with tyrosine or phenylalanine, or cofactor support with vitamin C, iron, tetrahydrofolate, and vitamin B6 may be beneficial.

NORMETANEPHRINE
Normetanephrine is low-normal (<20th percentile). Lower normetanephrine levels may be reflective of insufficient norepinephrine levels in the adrenal glands.

EPINEPHRINE
Epinephrine is within reference range. Epinephrine, also called adrenaline, functions both as a neurotransmitter and a hormone, participating in the body's fight or flight response. Epinephrine increases alertness, focuses attention, fine-tunes vigilance, increases blood pressure, heart rate, and blood glucose, reduces digestive activity, pain and sleep, prevents bladder emptying, and regulates body temperature.

VMA
Vanillylmandelic acid (VMA) is within reference range. VMA is a norepinephrine and epinephrine metabolite formed via the actions of monoamine oxidase, catechol-O-methyl transferase (COMT), and aldehyde dehydrogenase.

INFLAMMATORY MARKERS

KYNURENINE
Kynurenine is low-normal (<20th percentile). Kynurenine is a central metabolite of the amino acid tryptophan with vasodilatory properties. Kynurenine is utilized by the body in the production of niacin (vitamin B3), eventually leading to the formation of NAD+, which plays a pivotal role in energy metabolism, gene expression, cell death and regulation of calcium homeostasis. More than 90% of the body's tryptophan is metabolized to the kynurenine pathway.
Kynurenine is synthesized by the enzyme tryptophan dioxygenase, which is made primarily but not exclusively in the liver, and indoleamine 2,3-dioxygenase, which is made in many tissues in response to immune activation by interferons and cytokines, or free radicals. In the brain, approximately ~40% of kynurenine is produced locally, whereas the rest is absorbed from the blood.
Kynurenine degradation generates a series of neuroprotective and neurotoxic compounds that can activate or inhibit N-methyl-d-aspartate (NMDA) glutamate receptors (see kynurenic acid and 3-OH kynurenine). Upregulation of this pathway may be a hallmark of neuroinflammation and is associated with certain disorders.
Research shows that urinary kynurenine levels are low in autism spectrum disorder (Gevi, Zolla et al. 2016). Low kynurenine levels have been implicated in aggression (Comai, Bertazzo et al. 2016), depression (Umehara, Numata et al. 2017) and headaches (Curto, Lionetto et al. 2015).

TREATMENT CONSIDERATIONS: low kynurenine may be a sign of low tryptophan levels or low co-factors for the enzymatic metabolism.

KYNURENIC ACID
Kynurenic acid is low-normal (<20th percentile). Kynurenic acid is a neuroactive metabolite produced from kynurenine. Kynurenine is formed from tryptophan via the enzyme tryptophan dioxygenase and indoleamine 2,3-dioxygenase; and metabolized along two independent pathways to produce kynurenic acid via aminotransferases and 3-OH kynurenine.
Kynurenic acid (unless in excess amounts) is regarded to have a neuroprotective role because it inhibits the N-methyl-d-aspartate (NMDA) glutamate receptor, reduces the neurotransmitter glutamate release and thereby prevents excitotoxicity.
Mounting evidence suggests that kynurenic acid may be implicated in the pathophysiology of mood disorders. As a result, kynurenic acid has been considered for use in therapy in certain neurobiological disorders. Research shows that kynurenic acid is low with a low protein diet (Poesen, Mutsaers et al. 2015) and in Autism Spectrum Disorder (Gevi, Zolla et al. 2016). Low kynurenic acid is implicated in depression (Baranyi, Amouzadeh-Ghadikolai et al. 2017), headaches (Curto, Lionetto et al. 2015), bipolar disorder (Birner, Platzer et al. 2017) and Alzheimer's disease (Gulaj, Pawlak et al. 2010).

TREATMENT CONSIDERATIONS: consider increasing amino acids in the diet and improving inflammatory pathways.

3-HYDROXYKYNURENINE
3-Hydroxykynurenine is within range. 3-Hydroxy Kynurenine (3-OH Kynurenine) is a metabolic intermediate of the kynurenine pathway, one of the major metabolites of tryptophan degradation. Kynurenine is transformed into 3-OH Kynurenine, which acts as a N-methyl-d-aspartate (NMDA) glutamate receptor agonist and has been demonstrated to exert neurotoxic effects, especially when in excess.

XANTHURENIC ACID
Xanthurenic acid is within range. Xanthurenic acid is a metabolite of the kynurenine pathway, formed directly from 3-OH Kynurenine, and serves as an indirect marker of vitamin B6 status.

URINARY FREE CORTISOL (F) AND CORTISONE (E)

Urinary free cortisol (F) is following a normal circadian rhythm and levels of F are within expected reference ranges throughout the day, then slightly low at bedtime. In sharp contrast, cortisone (E), the inert metabolite of F, is lower than expected reference ranges throughout most ofthe

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day. This indicates low adrenal reserve, which is often associated with symptoms of adrenal insufficiency (e.g. fatigue).

Cortisol is converted to cortisone by the enzyme 11-beta hydroxysteroid dehydrogenase type 2 (11B-HSD2) (for review see: Seckl JR and Chapman KE Eur J Biochem 249, 361-364, 1997), which is expressed at higher levels in tissues such as the kidneys, liver, lungs, colon, adipose tissue, and salivary glands. This enzyme plays a key role in preventing excess buildup of cortisol in tissues, which at high level activates the mineralocorticoid receptor (at normal levels cortisol only activates the glucocorticoid receptors) and can lead to mineralocorticoid excess syndrome, causing high blood pressure and low potassium levels. High tissue levels of cortisol also increases deposition of body fat, especially around the waist (belly fat).

Consider adrenal support to help raise cortisol to optimal levels. For additional information about adrenal dysfunction and strategies for adrenal support and lowering stress/cortisol levels the following books and journal articles are worth reading: "Adrenal Fatigue," by James L. Wilson, N.D., D.C., Ph.D.; "The Cortisol Connection," by Shawn Talbott, Ph.D.; "The End of Stress As We Know It," by Bruce McEwen; "The Role of Stress and the HPA Axis in Chronic Disease Management" by Thomas Guilliams, PhD.

MELATONIN METABOLITE: 6-SULFATOXYMELATONIN (MT6s)

The urinary metabolite of melatonin, 6-sulfatoxymelatonin (MT6s), is high in the first and last urine voids. This U-shaped circadian rhythm is most commonly seen with use of oral melatonin in the evening before bed at night. Because MT6s falls to within reference range by second and evening voids this suggests that the melatonin supplement is appropriate. High melatonin during the day can cause excessive sleepiness.

When levels are elevated without supplementation, it may be a normal variant or due to oxidative stress.

When melatonin is within normal range but sleep issues are problematic, this condition may, more likely, be related to excessive stress(ors) or to other hormonal imbalances (low or high) in estrogens (necessary for REM sleep, excessive levels can be over stimulating), progesterone (metabolite allopregnanolone binds GABA receptors and has a calming effect), cortisol (low or high levels can disrupt sleep) and/or thyroid. If any of the symptoms of estrogen, progesterone, cortisol, or thyroid hormones appear to be imbalanced, consider testing them and correcting imbalances to facilitate better sleep.

For more general information about melatonin please see: http://www.nlm.nih.gov/medlineplus/druginfo/natural/940.html

DIURNAL NOREPINEPHRINE

Norepinephrine is within range during the night (1st collection), is within/near range throughout most of the day, and spikes again near bedtime Norepinephrine functions both as a neurotransmitter and a hormone, participating in the body's "fight or flight" response. Norepinephrine increases alertness, focuses attention, fine-tunes vigilance, increases blood pressure, heart rate, and blood sugar, reduces digestive activity, pain and sleep, prevents bladder emptying through bladder sphincter constriction, and regulates body temperature. The adrenal gland produces approximately 20% of norepinephrine with 80% produced by the sympathetic nerve fibers. An elevated level suggests sympathetic system activation.

HIGH NOREPINEPHRINE: High urinary norepinephrine is suspected to contribute to aggression, anxiety, attention impairment, depression, high blood pressure, hyperactivity, immune stress, insulin resistance, irritability, and sleep difficulties (Vincent et al., 2004).

THERAPEUTIC CONSIDERATIONS: Since norepinephrine is produced by the sympathetic nervous system and the adrenal glands, support of these two systems with supplements like adrenal adaptogens, tyrosine, phenylalanine, cofactor support of SAMe, Vitamin C, iron, MTHR, B6, and L-theanine may be beneficial.

DIURNAL EPINEPHRINE

Epinephrine is within normal ranges throughout the day. Epinephrine functions both as a neurotransmitter and a hormone, participating in the body's "fight or flight" response. Epinephrine increases alertness, focuses attention, fine-tunes vigilance, increases blood pressure, heart rate, and blood glucose, reduces digestive activity, pain and sleep, prevents bladder emptying, and regulates body temperature. Approximately 80% of peripheral catecholamine output by the adrenal glands accounts for epinephrine.

Creatinine levels reflect urine concentration.
Low values suggest overly dilute urine; High values suggest overly concentrated urine.
Extreme low or high values may be induced by kidney or other metabolic disorders, but most values will be due to inadequate hydration (high creatinine) or excessive water intake in the several hours prior to testing (low creatinine). Creatinine is used to adjust the lab results for kidney function. No samples were refused due to quality issues.

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