Balancing the Brain and Body

Nutrition, Exercise, Sleep, Hormones, and Sun Exposure

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¡VIDA! Educational Series
Educational Objectives

• Recognize non-drug therapies that improve health and wellness for psychiatric and medical conditions

• Discuss the importance of assessing nutrition, sleep, exercise, stress reduction, drug-drug interactions, deficiency states, supplements, and substance use in patient care

• Implement strategies for promoting non-drug therapies in clinical practice
The Brain is a Dynamic Ecosystem

- Regular intake of protein (i.e., essential amino acids) and complex carbohydrates are important for mood, sleep, energy and appetite regulation
- Exercise is important to release neurotransmitters
- Sleep is important to make and store neurotransmitters for the next day
- Hormones important for mood regulation (thyroid, estradiol, testosterone, vitamin D, etc)
What Makes Us Happy?

Regular intake of protein (i.e., essential amino acids) and complex carbohydrates are important for mood, sleep, energy, and appetite regulation.

- Every 3-5 hours interval
- Do not skip meals, particularly breakfast
- Eat slow to allow food to be digested, absorbed, and amino acids/glucose to enter the brain (30 minutes)
  - Serotonin – important for appetite regulation
- Drink water
Nutrition

- **Protein**
  - Complete proteins: all essential amino acids
    - Meat, poultry, fish, eggs, dairy
    - Soy ≠ diary
  - “Incomplete” proteins
    - Grains + legumes
    - Grains + nuts/seeds
    - Legumes + nuts/seeds

- **Essential fatty acids**
  - 80% of mammalian brain is lipid (long-chain polyunsaturated fatty acids)

- **Cholesterol**
  - Essential component of cell membrane development and the production of bile acids, adrenal steroids, vitamin D, and sex hormones

- **Complex carbohydrates** (low glycemic index)
  - Fruits, vegetables, nuts, legumes, grains

- **Vitamin and mineral supplements**

- **Water**
Protein-Rich Foods

• **Animal Proteins** (muscle meat or by-products from an animal) = complete protein
  ◦ Beef
  ◦ Venison, buffalo, other game
  ◦ Pork
  ◦ Poultry
  ◦ Fish
  ◦ Cottage cheese
  ◦ Cheese
  ◦ Milk
  ◦ Yogurt
  ◦ Egg
Incomplete Proteins

- Does not contain all of the essential amino acids
  - Vegetable proteins: grains, legumes, nuts, seeds, and other vegetables
- Must combine “incomplete” proteins to create “complete” proteins
  - Grains + legumes
  - Grains + nuts/seeds
  - Legumes + nuts/seeds
- By adding a small amount of animal protein (meat, eggs, milk, or cheese) to the above groups, you can create a complete protein
Omega 3,6 Fatty Acids

- Omega-3 fatty acids (cold water fish)
  - EPA/DHA
  - Walnuts & flaxseeds contain alpha-linolenic acid (ALA) that is converted to EPA/DHA
  - Fish oil supplements and omega 3 fortified eggs
  - Fewer inflammatory effects than omega-6

- Omega-6 fatty acids (meat/nuts/seeds/oils)
  - Corn, sunflower, safflower, soy, and cottonseed oil
  - More inflammatory effects
    - An important component of the immune response, blood clotting, and cell proliferation
Vitamin/Mineral Deficiency States

- Vitamin A (retinol)
- Vitamin B complex
  - B-1 (thiamine)
  - B-2 (riboflavin)
  - B-3 (niacin or nicotinic acid)
  - B-5 (pantothenic acid)
  - B-6 (pyridoxine)
  - B-7 or H (biotin)
  - B-9 (folate)
  - B-12 (cobalamin)
- Vitamin C (ascorbic acid)
- Vitamin D
- Vitamin E (tocopherol)
- Vitamin K
- Boron
- Calcium
- Chloride
- Chromium
- Copper
- Iodine
- Iron
- Magnesium
- Manganese
- Molybdenum
- Nickel
- Phosphorus
- Potassium
- Selenium
- Silicon
- Silicon
- Vanadium
- Zinc
Vitamin B12 Deficiency

- **Common Symptoms**
  - Feel weak, tired, and lightheaded
  - Have pale skin
  - Have a sore, red tongue or bleeding gums
  - Feel sick to your stomach and lose weight
  - Have diarrhea or constipation

- **If the level of vitamin B12 stays low for a long time, it can damage nerve cells:**
  - Numbness or tingling in your fingers and toes
  - A poor sense of balance
  - Depression
  - Dementia, a loss of mental abilities
Folate Deficiency

- Folic acid → folate (active)

- Common Symptoms
  - Diarrhea, loss of appetite, weight loss
  - Headaches, heart palpitations
  - Irritability
  - Abnormal paleness or lack of color in the skin
  - Lack of energy or tiring easily (fatigue)
  - Smooth and tender tongue
  - High homocysteine levels = multiple health problems

- Pregnant women with folate deficiency
  - Low birth weight, premature infants, and neural tube defects

- Infants and children with folate deficiency
  - Slow growth rate, language delay, autism spectrum disorder
Iron Deficiency

- Common Symptoms
  - Pale skin color, brittle nails, sore tongue
  - Fatigue, weakness, shortness of breath
  - Decreased appetite (especially in children)
  - Headache – frontal
  - Unusual food cravings (called pica)
  - Restless legs syndrome (uncomfortable feeling in legs, sensations of pulling, tingling, crawling, accompanied by a need to move the legs)
Neurotransmitter Synthesis

- Requirement of active folate, vitamin B12, vitamin D for the synthesis of major neurotransmitters in the body and brain
  - Serotonin
    - Involved in appetite, mood, sleep, migraines, bleeding
  - Norepinephrine
    - Involved in alert system, blood pressure, energy, motor action
  - Dopamine
    - Involved in pleasure, movement, focusing
Essential Amino Acids

- Histidine
- Isoleucine
- Leucine
- Lysine
- Methionine
- Phenylalanine $\rightarrow$ Tyrosine $\rightarrow$ Dopamine $\rightarrow$ Norepinephrine $\rightarrow$ Epinephrine
- Threonine
- Tryptophan $\rightarrow$ Serotonin $\rightarrow$ Melatonin
- Valine
Synthesis of Serotonin

- L-tryptophan (essential amino acid) $\rightarrow$ serotonin $\rightarrow$ melatonin (darkness)
  - L-tryptophan must cross the blood brain barrier and requires an energy pump
- Primary sources are from animal proteins and by-products (complete proteins)
  - Meat, poultry, fish
  - Eggs, dairy products
  - Soy (whole bean) – incomplete protein
  - Incomplete proteins: grains, nuts, legumes, seeds
Synthesis of Serotonin

Tryptophan

Tryptophan hydroxylase

5-hydroxytryptophan (5-HTP)

Aromatic amino acid decarboxylase

Serotonin (5HT)
Serotonin Deficiency States

- Anxiety, panic attacks, obsessive-compulsive behaviors
- Irritability, agitation, impulsivity, aggression
- Insomnia and sleep disruption
  - Serotonin → melatonin (under darkness)
- Depression
- Increased appetite
  - Aggression to kill animals for food
  - Over-eating and binge-eating behavior
  - Obesity
Serotonin Deficiency States

- Anxiety disorders: OCD
- Mood disorders: depression, mood swings
- Impulsivity: aggression, suicide
- Insomnia
- Eating disorders
- Premenstrual dysphoric disorder (PMDD)
- Decreased pain threshold
- Migraines

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Synthesis of DA and NE

- Phenylalanine (essential amino acid) $\rightarrow$ Tyrosine $\rightarrow$ Dopamine (DA) $\rightarrow$ Norepinephrine (NE)
  - Phenylalanine is in aspartame (Equal)

- **Food sources**
  - Complete proteins
    - Meats, Poultry, Fish, Eggs, Dairy
  - Incomplete proteins
    - Nuts, Grains, Beans, Legumes, Soy
Synthesis of DA/NE/E

- Phenylalanine
- Tyrosine
  - Tyrosine hydroxylase
  - DOPA
  - Dopamine (DA)
  - Norepinephrine (NE)
  - Epinephrine (E)
Drugs that Increase NE and/or DA Activity

- Caffeine
- Nicotine
- Cocaine
- Amphetamines/dextroamphetamine
  - Methamphetamine
  - Methylphenidate (Ritalin)
  - Atomoxetine (Strattera)
- Bupropion (Wellbutrin, Zyban)
- Desipramine (Norpramin)
- Modafinil (Provigil)
- Armodafinil (Nuvigil)

Parkinson’s Disease medications: dopamine precursors and agonists, MAO inhibitors, COMT inhibitors
Caffeine

- 80-85% of US adults consume caffeine
  - Most cultures use < 50 mg/d compared to 400 mg/d for US and European countries
- Stimulates norepinephrine and dopamine
- Use of > 250 mg (e.g. more than 2-3 cups of brewed caffeine)
  - Causes anxiety/panic, agitation/irritability, psychosis, insomnia, tachycardia, tremors, decreased tone of esophageal sphincter, gastritis
  - Causes vasoconstriction and lowers the seizure threshold
- Withdrawal reactions
  - Causes migraines
- Half-life elimination = 5-8 hours
Nicotine

- Stimulates dopamine and opioid activity
- Causes anxiety, insomnia, dizziness, headache, nausea, increased heart rate
- Withdrawal reactions (irritability, aggression, depression)
- Smoking increases liver enzymes and lowers blood levels of many medications and hormones (e.g., antipsychotics, antidepressants, caffeine, estradiol, testosterone)
What Makes Us Happy?

- Exercise/movement is important to release neurotransmitters and improves mood, concentration, and energy.
- Exercise increases dopamine, norepinephrine, and serotonin activity.
- Outdoor exercise increases sun exposure and the synthesis of vitamin D.
Movement and Activity

- Improves cerebellar functioning
- Increases growth of new receptors in the brain
- Improves the tone of the locus ceruleus
- Improves attention by activating the basal ganglia
- Helps regulate the amygdala
- Increases the volume of the prefrontal cortex

Touch/Movement/Exercise and the Brain

**Touch**
- Repetitive movements = neurotransmitter release
- Sexual activity = release of dopamine, oxytocin, vasopressin
- Acupuncture/ Acupressure = neurotransmitter release

**Movement/Exercise**
- Weight training, running, walking, yoga, Pilates, etc.
- Decreases anxiety and depressive symptoms
- Improves stress tolerance, energy, and memory/concentration
- Improves health and well-being
- Lowers insulin levels and body fat
Exercise for the Brain

- Physical exercise protects and enhances the brain
- Moderate exercise improves blood flow to the brain, which increases oxygen and glucose delivery
- Exercise stimulates neurogenesis, the ability of the brain to make new neurons
- Improves sleep
- Reduces the risk of depression
- An active sex life leads to a longer life, better heart health, and better brain function ¡Vida!
What Makes Us Happy?

- Sleep is important to make and store neurotransmitters for the next day.

- Maximum REM sleep = 8 hours
  - REM is when serotonin and norepinephrine are synthesized and stored.
  - Need 10-12 hours per day for children and adolescents

- Naps (REM sleep) make more neurotransmitters
Sleep Stages During a Night

![Graph showing sleep stages over a night's duration with stages 1 to 4 and REM periods indicated.]
Sleep Deprivation

- < 8 hrs/day (75% of adults in US)
- Increased accidents
- Impaired work performance
- Impaired physical and mental health
  - Increased stress, aggression, anxiety, depression and weight gain
  - Increased disease states
    - Cardiovascular disease and stroke
    - Diabetes and obesity
    - Cancer risk
  - Rapid/accelerated aging
Sleep Deprivation (sleep-debt)

- Carbohydrate metabolism
  - Increased glucose levels
  - Decreased glucose tolerance
- Thyroid function
  - Decreased thyrotropin at night
- Hypothalamic-pituitary-adrenal axis
  - Increased cortisol levels in afternoon and evening
  - Increased sympathetic nervous system activity
- Immune function
  - Decreased interleukin-7 levels
- REM sleep deprivation = weight gain
Risk Factors of Poor Sleep

- Using caffeinated products in the afternoon or evening
- Drinking alcohol in the evening
- Taking stimulating medications or drugs in the late afternoon or evening
  - CNS stimulants impact on sleep
- Eating a large meal near bedtime, particularly with gastroesophageal reflux disease or delayed gastric emptying
- Exercising close to bedtime
- Sleep apnea
- Restless leg syndrome
Risk Factors of Poor Sleep

- Following an irregular morning and nighttime schedule or working evening shifts or traveling to different time zones
- Having acute stress, anxiety, depression, and chronic pain
- Aging adults may have more sleep disruptions during the night (sleep apnea, restless leg syndrome, hot flashes)
- Being overweight increases the risk of sleep apnea
Treatment for Insomnia

- Nonpharmacologic treatments for chronic insomnia are effective in 70-80% of patients
  - Complete protein + complex carbohydrate prior to bedtime (e.g., dairy + fruit)
    - L-tryptophan $\rightarrow$ serotonin $\rightarrow$ melatonin
  - Dawn to dusk simulation
  - Dark, cool room
  - Decrease noise (ear plugs, white noise)
  - Progressive muscle relaxation/biofeedback/cognitive therapy
  - Avoid caffeine 8-10 hours prior to bedtime
  - Avoid alcohol prior to bedtime
  - Avoid exercising within 2-3 hours of bedtime
- Power napping (15-30 minutes) = “siesta” = REM sleep
What Makes Us Happy?

- Hormones are important for mood regulation and whole body health
  - Thyroid functioning
  - Gonadal hormone functioning
    - DHEA $\rightarrow$ testosterone $\rightarrow$ estradiol
  - Vitamin D is synthesized from UV light
    - Less sun exposure, sun block, and protective clothing = deficiency states
Vitamin D Deficiency

- Rickets, osteopenia, osteoporosis, osteomalacia
  - Must have calcium + vitamin D
- Cancer
  - Colon, prostate, breast, ovarian, pancreatic
- Cardiovascular diseases
  - Hypertension
- Autoimmune diseases
  - Multiple sclerosis and Type 1 diabetes
- CNS disorders
  - Neurodevelopmental disorders, neurological disorders, mood disorders
Vitamin D

- Improves bone density, muscle strength, and skin
  - Lower risk of osteopenia, osteoporosis, osteomalacia, fibromyalgia, and wrinkling
- Improves mood
  - Lower rates of depression, seasonal affective disorder, and bipolar disorder
- Improves immune functioning
  - Lower rates of influenza, autoimmune disorders, asthma, and cancer
- Improves metabolic functioning
  - Lower rates of diabetes
Vitamin D

- Improves cardiac functioning
  - Lower rates of hypertension
- Improves gastrointestinal functioning
- Improves neurodegenerative disorders
  - Lower rates of dementia, Parkinson’s disease, multiple sclerosis, schizophrenia, autism spectrum disorder

- Vitamin D Council: http://www.vitamindcouncil.org
Risk of Vitamin D Deficiency

- Darker skin
- Winter months / lack of sunlight (UV radiation)
- SPF $\geq 30$ sunscreen and protective clothing
- Lack of fortified foods or supplements
- Elderly
- Infants and children
- Pregnant or lactating women
- Hospitalized/institutionalized patients
- Chronic renal and/or liver disease
- Gastrointestinal diseases or gastric bypass
- Obesity
- Drug interactions
Sources: Dietary

- **Dietary vitamin D sources:** Cod liver oil, cold water fish (salmon, mackerel, herring), egg yolks, fortified milk, butter, cereals, and orange juice
  - Fatty fish such as salmon, cooked, 3.5 oz, 360 IU
  - Mackerel, cooked, 3.5 oz, 345 IU
  - Sardines, canned in oil, drained, 3.5 oz, 270 IU
  - Eel, cooked, 3.5 oz, 200 IU
  - Fish oils such as cod liver oil, 1 Tbs, 1,360 IU
  - Egg yolk - one whole yolk, 20-25 IU
  - Liver, beef, cooked, 3.5 oz, 20 IU
# 25-hydroxy vitamin D (25[OH]D)

<table>
<thead>
<tr>
<th>Serum Levels (ng/mL)</th>
<th>Health Status</th>
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<tbody>
<tr>
<td>&lt; 10</td>
<td>Deficiency: associated with vitamin D deficiency and rickets in infants and young children</td>
</tr>
<tr>
<td>10-20</td>
<td>Generally considered inadequate for bone and overall health in healthy adults</td>
</tr>
<tr>
<td>20-30</td>
<td>Sufficient for bone health but insufficient for whole body health</td>
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<tr>
<td>≥ 30-100</td>
<td>Proposed as desirable for overall health and disease prevention: 50-70 ng/mL target levels</td>
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<tr>
<td>&gt; 150-200</td>
<td>Considered potentially toxic, leading to hypercalcemia and hyperphosphatemia</td>
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• **Vitamin D2 (ergocalciferol)**
  - Produced from ergosterol in a variety of plants and yeast by UVR
  - Lower levels of 25[OH]D than vitamin D3

• **Vitamin D3 (cholecalciferol)**
  - Animal/fish sources, supplementation or fortification of dairy
  - Produced from 7-dehydrocholesterol in the skin under the influence of UVB radiation (UVR)
  - Stable to heat, light, and storage
  - More active than vitamin D2
Vitamin D3 Supplementation

- Higher daily doses may be needed based on 25-OH-D Levels and risk factors
  - Low risk deficiency: 400 IU/d → 1000 IU/d
    * Adequate sun exposure for synthesis
  - High risk deficiency: 800 IU/d → 10,000 IU/d
  - Pregnancy and lactation: 1000 IU/d → 4000 IU/d
  - Winter months or higher altitudes: 1000 IU/d → 4000 IU/d
  - Non-hispanic blacks and Mexican-Americans may needed higher doses: 1000-2000 IU/d → 4000 IU/d
How to Take Better Care of Your Brain and Body

- Nutrition
- Sleep
- Exercise
- Hormonal balance
- Minimizing substances and drugs that impact on mental and physical health
- Sun exposure or vitamin D supplements
- Vitamin and mineral supplements, omega 3 fatty acids, etc.
- Stress reduction

QUESTIONS?

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