How Nutrition Changes the Aging Brain

MULTIPLE SCLEROSIS & OTHER NEUROLOGICAL DISEASES

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Outline for Lecture

• Topics from Lecture #5
• Multiple Sclerosis
• Parkinson’s disease & gut microbiome
• Epilepsy
• Diabetes
• Rheumatoid Arthritis
• Course Conclusion
Transportation into Blood Brain Barrier

- **blood**
- **tight junction**
- **endothelium**
- **basement membrane**
- **astrocyte**
- **brain**
Transportation into Blood Brain Barrier

- Passive Diffusion
- Active Diffusion
Blood Brain Barrier
Cannabis

Psychoactive cannabinoid
delta-9-tetrahydrocannabinol (THC)

Anti-psychoactive cannabinoid
cannabidiol (CBD)
Cannabis

• high levels of CBD
• very low insignificant levels of Δ9-THC
• “industrial hemp,” or “hemp”
• no psychoactive effects
Cannabis

- Endocannabinoid system (ECS)
  - Modulates bodily functions
    - Appetite
    - Sleep
    - Cognition
  - Present in the nervous system
Cannabis Receptors

• 2 types of receptors That THC binds to
  1. CB1
  2. CB2
Turmeric

• In India, no data on incidence of stroke or neurodegeneration
• Lower rate of cancer
• High spice intake
• Plant based diet
• High intake of fruits, vegetables, and legumes

• Highest amount of antioxidants
Multiple Sclerosis

demyelinating disease
environmental risk factors
autoimmune
MULTIPLE SCLEROSIS

Healthy

Nerve affected by MS

Node of Ranvier

Schwann cells

Nerve fiber

Damaged myelin

Exposed fiber
Multiple Sclerosis rates and where you live

Rates of MS are higher farther from the equator

NORTHERN STATES
110 - 140 CASES PER 100,000 PEOPLE *

SOUTHERN STATES
57 - 78 CASES PER 100,000 PEOPLE *

37TH PARALLEL

GLOBAL MEDIAN PREVALENCE OF MS:
30 PER 100,000 PEOPLE
The following countries have the highest incidence of MS per 100,000 people

Canada: 291

Norway: 160
Sweden: 189
U.K.: 164
Denmark: 227
Germany: 149
Czech Republic: 160
Hungary: 176
San Marino: 250
Cyprus: 175
Multiple Sclerosis & Vitamin D

- Vitamin D deficiency a risk factor for multiple sclerosis
- In the central nervous system, Vitamin D plays a role in:
  - regulation
  - proliferation
  - differentiation
  - immunomodulation
Basic Science and Multiple Sclerosis

- In laboratory animals....
- Vitamin D deficiency responsible for worsening of symptoms
- Supplementation with vitamin D made symptoms disappear

- Human Data not clear
Recent human study from McGill University.....

• Investigated the link between Vitamin D metabolism and risk of Multiple Sclerosis development

• European population

• Single nucleotide polymorphisms (SNPs) of enzymes involved in Vitamin D metabolism

Mokry et al., 2015
Single nucleotide polymorphism (SNPs) is a variation in a single nucleotide which may occur at some specific position in the genome (DNA).
Study investigated genetic changes in enzymes involved in vitamin D metabolism.
Findings……

• Genetically lowered levels of 25OHD associated with increased risk of Multiple Sclerosis in European population
Multiple Sclerosis, Vitamin D and Fatigue

https://www.youtube.com/watch?v=LFL4jDPIXsk
Multiple Sclerosis

• The further from the equator a person lives, the higher risk of developing disease

• Sunlight is the body’s most efficient source of Vitamin D, suggesting exposure to sunlight may offer from Multiple Sclerosis

• Group of nurses took 400 international units of vitamin D daily, less risk of developing Multiple Sclerosis
Multiple Sclerosis

• Institute of medicine recommends:
  • 600 international units of vitamin D/day for people aged 19-70 years
  • 800 international units for adults aged 71+

• Some doctors think 4000 international units/day of vitamin D are needed
Parkinson’s disease (PD) and the gut microbiome
Parkinson’s disease (PD) and the gut microbiome

- Gastrointestinal dysfunction in preclinical PD
- Abnormalities in gastrointestinal tract of PD vs. control
- Does the disease originate in the gut?
- Dual hit hypothesis
- PD altered gut microbiota composition and varying bacterial concentrations correlated with distinct disease phenotypes

Mau and Jadavji, 2017
Parkinson's disease (PD) and the gut microbiome

• Bacterial produce short chain fatty acids that can cross blood brain barrier

• Stimulate inflammation in brain

• Microbiota may play a significant role in PD

• Replacing with healthy microbiota via fecal transplant may decrease phenotype

Mau and Jadavji, 2017
Epilepsy
Epilepsy

• **Seizure**: burst of electrical activity in your brain like an electrical storm

• **Activity** causes different symptoms depending on type of seizure and brain region involved.
Epilepsy & Nutrition

• Steady energy release foods
• People with epilepsy should have a balanced diet (carbs, fats, proteins, veg and fruit)
• Avoid swings of blood sugar
• Anticonvulsants may interfere with body’s ability to absorb vitamin B12, K, D, Calcium and Magnesium
• Large amounts of alcohol are concerning – may interfere with anticonvulsants medication
Epilepsy & Nutrition

KETOGENIC DIET

• High fat diet
• Majority of caloric intake is obtained from fatty foods
• Quite unpalatable and difficult to maintain

• Excessive fats produce ketones
• Ketone production has been shown to help control seizures
• Often used when anticonvulsants are ineffective
Questions?
Break!
Diabetes
Diabetes

- Body’s ability to produce or response to hormone, insulin, is impaired
- Results in abnormal metabolism of carbohydrates and elevated levels of glucose in blood and urine
Diabetes

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Diabetes

Type I
• Juvenile diabetes or insulin dependent
• Pancreases produces little to no insulin
• Chronic condition, no cure
• Appears during childhood/adolescence, it can develop in adults
Diabetes

Type 2

- Adult onset or non-insulin dependent diabetes
- Chronic condition
- Affects the way your body metabolizes sugar (glucose)
- Body resists the effects of insulin
- OR is doesn’t produce enough insulin to maintain normal glucose levels
- No cure
- Managed by eating well, exercising, and maintaining healthy weight
Best Foods for Diabetes

- Barley Grass
- Kale Salad
- Green Juice
- Raw Zucchini with Tomato Sauce
- Guacamole
- Avocado Sprouts Salad

Worst Foods for Diabetes

- Pancakes and Syrup
- Soda
- French Fries
- Bacon
- Canned Fruit
- Milk
- Fast Food Hamburgers
- Ketchup
- Potato Chips
Diabetes & Carbohydrates

• Monitoring carbohydrate intake for good health
• Intake of veggies, fruit, whole grains, legumes and dairy > benefits
  than in fat, sugars or sodium
Diabetes & Glycemic Index & Load

- Substituting low glycemic foods for higher foods
- Helps controls glycemic load
Diabetes & Fructose

• “Free fructose” occurring in foods such as fruits may result in better glycemic control
• Avoiding sweeteners including high fructose corn syrup and sucrose
  • Increase weight gain
  • Worsening of cardio metabolic risk profile
Diabetes & Total Fat

• Fat quality > quantity
Diabetes & Omega 3 fatty acids

• No evidence for the benefits of supplementation
• Follow general public recommendations, which indicate increase in omega-3 fatty acid intake
Diabetes & Micronutrients

• No clear evidence of benefit from vitamin or mineral supplementation

• Importance of individualized meal planning to include optimization of food choices to get all micronutrients
Diabetes & Sodium

• People with diabetes and hypertension need to future reduce sodium intake
**DIABETES**

- **Vitamin B12**
  - Deficiency common in diabetics because metformin depletes B12.12
  - Helps insulin attach to cell's receptors increasing glucose uptake into cell; Deficiency can cause insulin resistance. Supplementation trials show dose-dependent benefits for type II diabetics.7,19,20

- **Vitamin B3**
  - Preserves B-cell function in type 1 diabetics; Part of GTF (glucose tolerance factor) which facilitates insulin binding.3,4,5

- **Vitamin D**
  - Lowers risk of type 1 and 2 diabetes; Suppresses inflammation of pancreatic B-cells; Vitamin D receptor gene linked to diabetes.6,7,8

- **Vitamin E**
  - Confers protection against diabetes by protecting pancreatic B-cells from oxidative stress induced damage; May prevent progression of type 1 diabetes.9

- **Vitamin C**
  - Lowers glycylated hemoglobin (HbA1c) and fasting and post-meal glucose levels in type 2 diabetes.10,11,12

- **Biotin**
  - Stimulates glucose-induced insulin secretion in pancreatic B-cells; High dose biotin can improve glycemic control in diabetics.13,14,15

- **Magnesium**
  - Deficiency reduces insulin sensitivity; Low magnesium exacerbates foot ulcers in diabetics.16,17

- **Zinc**
  - Needed in the synthesis, storage and secretion of insulin; Protects pancreatic B-cells from damage; Affects the expression of genes linked to diabetes.18,19,20

- **Lipoic Acid**
  - Enhances glucose uptake in skeletal muscle tissue; Improves glucose tolerance in type 2 diabetics; Very effective treatment for diabetic neuropathy.21,22,23

- **Glutathione & Cysteine**
  - Glutathione-containing enzymes protect B-cells which are particularly sensitive to oxidative stress; Type 2 diabetics have abnormal antioxidant status; Supplementation with the glutathione precursor cysteine restores antioxidant status.24,25,26

- **Coenzyme Q10**
  - Protects kidney from diabetes related damage; Improves glycemic control in type 2 diabetes.27,28

- **Chromium**
  - Helps insulin attach to cell's receptors increasing glucose uptake into cell; Deficiency can cause insulin resistance. Supplementation trials show dose-dependent benefits for type II diabetics.14,19,20

- **Inositol**
  - Evidence suggests that inositol may be effective in treating diabetic neuropathy.29,30

- **Carnitine**
  - Reduces and even prevents pain from diabetic neuropathy; Improves insulin sensitivity by increasing glucose uptake and storage.31,32,33

- **Glutamine**
  - Stimulates a hormone called GLP-1 (glucagon-like peptide 1) that regulates insulin secretion after meals; Improves insulin signaling and sensitivity.34,35

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Rheumatoid Arthritis
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• Autoimmune disease
Rheumatoid Arthritis

• Inflammation of one or more joints
• Symptoms: joint pain, stiffness, decrease in range of motion
• Gets worse with age
Rheumatoid Arthritis & Nutrition

• Increased risk of cardiovascular disease and osteoporosis

• Treatments include:
  • Nonsteroidal anti-inflammatory drugs (NSAIDs)
  • Slow acting anti-rheumatic drugs
  • Corticosteroids

• All aim to reduce the patients’ pain, joint inflammation and progression of disease
• Treatments are totally effective and have side effects, such as gastro-intestinal bleeding
Rheumatoid Arthritis & Nutrition

• Treatments are totally effective and have side effects, such as gastro-intestinal bleeding

• Some drug therapies have anti-nutrient effects
  • Increase requirements of some nutrients
  • Decrease absorption

• Side effects results in alternative therapies, e.g. dietary supplements
Rheumatoid Arthritis & Omega-3 fatty acids

• Evidence suggests supplementation has benefits on the number of tender joints

• Data from 13 double blind, placebo controlled studies
Rheumatoid Arthritis & Antioxidants

- Vitamin E, C, and Selenium
  - Supplement studies have shown no positive effect with dietary supplementation
  - Patients with Rheumatoid Arthritis should be encouraged to meet recommendations
Rheumatoid Arthritis & Folic Acid

- Methotrexate (MTX) is an anti-rheumatic drug
- Also a folate antagonist

- Side Effects include: gastrointestinal intolerance mimic complicated folate deficiency

- Folate stores are depleted in patients on MTX

- Folic acid supplementation (<5mg/week) beneficial in patients with Rheumatoid Arthritis being treated with MTX
Rheumatoid Arthritis & Iron

- No evidence of benefits with iron supplementation
- Adequate dietary intake of foods rich in iron
Rheumatoid Arthritis & Foods Associated with Aggravating Symptoms

- Control studies involving inclusions of foods (e.g. red meat, wheat, gluten) have reported inconsistent results
Rheumatoid Arthritis & Foods Associated with Aggravating Symptoms

• To confirm which food produce symptoms blind challenges tests with capsules of the alleged food antigens are essential to overcome placebo effect

  • Patients do not show deterioration with blinded challenge
  • Small number of patients experience alleviation

• No food or food groups have consistently identified as a cause, trigger or aggravating factor.
Take home points

- Individual
- Aging
- Nutrition

Factors:
- Cognitive Reserve
- Environment
- Diet
- Education
- Genetics
How to implement the Mediterranean diet

1) Re-think meat
2) Increase plant based meals
3) Batch cook whole grains
4) Eat Vegetables
5) Snack on fruits and nuts
6) Change your fats
7) Add herbs and spices, decrease sale
Nutrition Services @ Loblaws

Registered dieticians

Click here to go to website
Resources
Lecture Materials & Resources

https://carleton.ca/linr/winter-2018-session/class-notes/
Future learning: Nutrition

- The Institute of Holistic Nutrition: Ottawa campus
  - [http://www.instituteofholisticnutrition.com](http://www.instituteofholisticnutrition.com)

Text Books Available on Amazon:

**Whole: Rethinking the Science of Nutrition**
by [T. Colin Campbell, Howard Jacobson](http://www.instituteofholisticnutrition.com)

**The China Study: The Most Comprehensive Study of Nutrition Ever Conducted and the Startling Implications for Diet, Weight Loss and Long-term Health**
by [T. Colin Campbell](http://www.instituteofholisticnutrition.com)

**Introduction to Human Nutrition 2nd Edition**
by [Michael J. Gibney, Susan A. Lanham-New, Aedin Cassidy, Hester H. Vorster](http://www.instituteofholisticnutrition.com)
Future Learning: Neuroscience

YouTube Channel: Neuro Transmissions
https://www.youtube.com/user/neurotransmissions

Alzheimer's disease blog (for non-scientists)
https://alzscience.wordpress.com/

List of Neuroscience Blogs:
http://www.prymd.com/blog/the-best-brain-blogs-neuroscience-for-the-non-scientific/
Future Learning: Neuroscience

THE BRAIN THAT CHANGES ITSELF

Stories of Personal Triumph from the Frontiers of Brain Science

"The power of positive thinking finally gains scientific credibility. Mind-bending, miracle-making, reality-busting stuff... Straddles the gap between science and self-help." —The New York Times

Norman Doidge, M.D.
Future Learning: Neuroscience

Save Your Mind: Seven Rules to Avoid Dementia
Paperback – Apr 20 2017
by Antoine Hakim (Author)

Mass Market Paperback
CDN$ 22.43
9 Used from CDN$ 16.95
14 New from CDN$ 22.43

The Globe and Mail Bestsellers
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Questions?