How Nutrition Changes the Aging Brain

Vascular Dementia and Dietary Influences on Cognition in Aging

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Outline of Presentation

- Topics from Lecture #3
- Introduction to vascular dementia
- How does nutrition impact vascular dementia
- Questions
- Break
- Dietary influences on cognition
- What are clinical trials?
Lecture Materials & Resources

https://carleton.ca/linr/winter-2018-session/class-notes/
Future Learning: Nutrition text books

Available on Amazon:

Whole: Rethinking the Science of Nutrition
by T. Colin Campbell, Howard Jacobson

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

Introduction to Human Nutrition 2nd Edition
by Michael J. Gibney, Susan A. Lanham-New, Aedin Cassidy, Hester H. Vorster
Future Learning: Neuroscience
Future Learning: Websites

- Peer reviewed literature

- Nutrition Facts
  - https://nutritionfacts.org/

- Mayo Clinic
  - https://www.mayoclinic.org/healthy-lifestyle/nutrition-and-healthy-eating/basics/nutrition-basics/hlv-20049477
Requirements of Nutrients & Vitamins during aging

- serving sizes get smaller, as we get older

<table>
<thead>
<tr>
<th></th>
<th>Adults age 51+</th>
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<tbody>
<tr>
<td></td>
<td>Males</td>
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<tr>
<td>Vegetables and Fruit</td>
<td>7</td>
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<tr>
<td>Grain Products</td>
<td>7</td>
</tr>
<tr>
<td>Milk and Alternatives</td>
<td>3</td>
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<tr>
<td>Meat and Alternatives</td>
<td>3</td>
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</tbody>
</table>
B-vitamins

**Vitamin B6:** This vitamin is essential for a healthy immune system and you need more after age 50. Good sources include potatoes, beans, meat, chicken and fish. If you think you’re not eating enough of these foods, check with your doctor about taking a supplement.

**Vitamin B12:** This vitamin is found in meat, chicken, fish and milk products. Up to 30% of adults over age 50 may have trouble absorbing vitamin B12, and may need supplements or B12 injections. Your doctor can perform a simple blood test to check your vitamin B12 status.
Vitamin D, Calcium, & Iron

**Vitamin D:** We can make vitamin D from the sun’s rays, but cold and dark Canadian winters mean many older adults do not get enough. Health Canada says that in addition to eating vitamin D-rich foods like milk and fish, everyone over age 50 should take a supplement with 400 IU of vitamin D daily.

**Calcium:** To keep bones strong, daily calcium needs increase to 1200 mg at age 50 for both women and men. The best sources include milk, cheese, yogurt and fortified soy beverages. Talk to your doctor if you do not eat three servings of milk and alternatives each day, since you may need calcium supplements.

**Iron:** Iron needs decrease in women over age 50 (from 18 mg of iron down to just 8 mg daily). Men need 8 mg for all of their adult life. Good sources of iron include beef, poultry, beans, leafy greens and fortified breakfast cereals.
Websites

Eating Right Ontario
https://www.eatrightontario.ca/en/Articles/Seniors-nutrition/Older-adults-eating-well

Dietitians of Canada
Impact of sugar on brain function

• When your body breaks down sugar, inflammatory process is initiated

• Too much sugar causes cognitive impairment

• Too much sugar has been shown to age neurons

• Cause insulin resistance
Impact of sugar on brain function

• When your body breaks down sugar, inflammatory process is initiated

• Too much sugar causes cognitive impairment

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• Cause insulin resistance
Introduction to Vascular Dementia

- Overall: problems with reasoning, planning, judgement, memory, and other thought processes
Causes of Vascular Dementia

- Strokes, blocks an artery in your brain
- Damaged to blood vessels, reduce circulation, depriving brain of oxygen and nutrients
- Narrowed of chronically damaged blood vessels
- High blood pressure, cholesterol, homocysteine levels
- Smoking
Symptoms of Vascular Dementia

• Confusion
• Trouble with attention and concentrating
• Reduced ability to organize thoughts or actions
• Decline in ability to analyze situation, develop an effective plan and communicate to others
• Difficulty decided what to do next
• Problems with memory
• Restlessness and agitation
• Unsteady gait
• Depression
Review of Vascular Dementia

https://www.youtube.com/watch?list=PL6Qsh0P6vDZKyjAyUYidyPk2ILBZCD1ul&time_continue=18&v=GdkU5vClpaU
Prevention of Vascular Dementia

- Healthy blood pressure
- Cholesterol
- Prevent and control diabetes
- Quit smoking
- Physical exercise
Nutrition and Vascular Dementia Study

• Vascular dementia is the second most common type of dementia

• Nutrition is a modifiable risk factor

• Antioxidants, including vitamin E and C and fatty fish were found to be protective

• Fried fish, increase homocysteine, decrease folic acid and increase risk for vascular dementia

• Evidence for dietary lipids is inconsistent

Purez et al., 2010
Nutrition and Vascular Dementia Study

- Evidence for dietary lipids is inconsistent
  - Midlife serum elevated cholesterol may increase risk
  - Late life elevated cholesterol maybe decrease risk

Purez et al., 2010
Vitamin D and Dementia

• Vitamin D deficiency has adverse effects on neurocognitive health and subcortical function

• Study investigated 25-hydroxyvitamin D (indicator of Vit D status) and dementia in elders receiving home care

• Subjects: 66-99 years old

• Duration: 2003-07

Buell et al., 2010
Vitamin D and Dementia

• Results
  • Higher prevalence of dementia with patients with 25-hydroxyvitamin D deficiency (<20ng/ml)
  
  • 25-hydroxyvitamin was associated with increased white matter hyperintensity volume, grade and prevalence
  
  • Adjustment for age, race, sex, body mass index and education associated with 25-hydroxyvitamin D deficiency (<20ng/ml) associated with twice the odds of dementia

Buell et al., 2010
Vitamin D and Dementia

https://www.youtube.com/watch?v=8WW6WybT9IE
Docosahexaenoic acid (DHA)

- Risk of dementia double every 5 years after 65
- Docosahexaenoic acid (DHA), omega-3 fatty acid
  - Neuroprotective
  - Reduced production beta amyloid peptide (thought to start AD)
  - Reduction of neuro inflammation
  - Decrease oxidative damage
  - Increase brain derived neurotrophic factor (BDNF)

Cole & Frautschy, 2010
Docosahexaenoic acid (DHA)

- Clinical trials suggest DHA or fish oil can slow early stages of progression
- BUT maybe specific to apolipoprotein E genotype
- Larger trials needed to determine efficacy

Cole & Frautschy, 2010
Omega 3 & 6 fatty acids

• Omega 6 fatty acids → some are pro-inflammatory
• Diet needs to be balance of omega 3 & 6 fatty acids

• Examples

<table>
<thead>
<tr>
<th>Omega 3</th>
<th>Omega 6</th>
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</thead>
<tbody>
<tr>
<td>Fish (e.g. tuna, cod)</td>
<td>Corn oil</td>
</tr>
<tr>
<td>Flax</td>
<td>Poultry</td>
</tr>
<tr>
<td>Hemp</td>
<td>Nuts</td>
</tr>
<tr>
<td></td>
<td>Cereal</td>
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<td></td>
<td>Eggs</td>
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</table>
Polyphenols

- Blueberry, strawberry, grape, and plum juices/extracts
- Positive effects in rodents (cognition)
- Polyphenols in juice/extracts maybe causing positive effects
- Grapes – resveratrol
- Blueberries - pterostilbene

Improve cognition in rodents

Cherniack et al., 2012
Polyphenols

Fig. 1. Potential mechanisms for polyphenol activity against dementing illness.

Cherniack et al., 2012
Polyphenols

- Mechanisms of action
  - Anti-inflammatory
    - Reduce vascular inflammation by decreasing producing of adipocyte generated inflammatory cytokines
  - Protect brain vasculature against pro-inflammatory state induced by metabolic syndrome
  - Neuroprotective effects, e.g. resveratrol, reduce neuron loss
  - Clinical trials underway in US of polyphenols

Cherniack et al., 2012
Polyphenols

- Improve insulin sensitivity, glucose, and insulin levels in rodent and preliminary human trials

Cherniack et al., 2012
Polyphenols

• Consideration
  • Optimum aged for initiation of therapy
  • Bioavailability – proportion of drug enters circulation when introduced into the body
  • How do they cross blood brain barrier
  • Sugar (comorbidities, diabetes)

Cherniack et al., 2012
Risk of dementia in Asian Population

• 2014: 33% of Japanese population is over 60 years old (aging population)
• Study to determine risk of dementia in Asian population based on diet
• 1006 subjects
• 60-79 years old
• Monitored diet for 15 years
• Diet of soya, vegetables, algae, milk and dairy products, lower levels of rice = lower incidence of dementia

Ozawa, 2013
Questions?
Break!
Dietary influences on cognition in aging
Mediterranean diet

https://www.youtube.com/watch?v=eYnPdn1_hkU
Mediterranean diet

MEDITERRANEAN DIET =
Healthy Fats + Protein + Unrefined Carbs + Unlimited Non-starchy Veggies
Every Time You Eat... Every Meal & Every Snack!

Use this diagram to know which foods fall into more than one macronutrient group.
Mediterranean diet

- Data that links better cognitive function to a diet high in
  - Fruit
  - Vegetables
  - Nuts
  - Cereals
  - Legumes
  - Fish
  - Extra virgin olive oil
  - Low intake of saturated fats and high glycaemic carbs

- Rich in antioxidants, anti-inflammatory, and decreases metabolic syndrome
- Slow progression from MCI to dementia
High GI vs Low GI Foods

Blood Glucose Levels vs Time/Hours

High GI Foods:
- Chips
- Biscuits, Cakes
- Ice cream, Dates
- Jasmine rice
- Potatoes
- Processed Food
- Watermelon
- White Bread

Low GI Foods:
- Basmati Rice, Vegetables, Lentils, Pasta, Wholegrain Bread, Oats, Oranges

Graph adapted from: www.gisymbol.com (University of Sydney). Images from Microsoft Clipart.
Dietary patterns and components that are correlated and delayed and accelerated cognitive decline

<table>
<thead>
<tr>
<th>DIET positive</th>
<th>DIET negative</th>
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<tbody>
<tr>
<td>• Caloric Restriction</td>
<td>• Over nutrition</td>
</tr>
<tr>
<td>• Mediterranean Diet</td>
<td>• Western diet</td>
</tr>
<tr>
<td>• Vitamins E, B6, B12 and folate</td>
<td>• Vegetable old/high omega-6 and omega-3 ratio</td>
</tr>
<tr>
<td>• Polyphenols</td>
<td>• Refined carbohydrates and sugar</td>
</tr>
<tr>
<td>• Oily fish/omega-3</td>
<td>• Hydrogenated fats/trans fats</td>
</tr>
<tr>
<td>• Olive oil/monounsaturated fat</td>
<td></td>
</tr>
<tr>
<td>• Fruit, vegetables, whole grains and legumes, fibre</td>
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Saturated fats

• Example: Beef, pork, butter, lam
• High intake associated with obesity and type 2 diabetes and cognitive impairment
• Elderly a diet high in saturated fats accelerates cognitive decline

• Role of insulin in cognition, diet increase in saturated fats creates insulin insensitivity leading to cognitive
Trans fats

- Examples margarine, doughnuts, breakfast sandwiches
- Intake of partially hydrogenated trans-unsaturated fats risk factors for cognitive decline
- Mechanism: increase in low density lipoprotein (LDL)
- Increase in levels of LDL risk factor for Alzheimer's disease
- Man made trans fats associated with obesity, type 2 diabetes and insulin insensitivity → risk factor of Alzheimer's disease
Omega-6 fatty acids

- Examples vegetable oils
- Western diet is high in omega 6 fatty acids
- Mostly due to high intake of vegetable oil (including corn, soya bean, and sunflower seeds)

- Decreasing levels of omega 6 fatty acids could prevent further progression
Omega-3 fatty acids

• Examples include: walnuts, fish
• Western diet is low in these
• Fatty acids are important components of cell membranes
• DHA exchange between plasma and brain is 4-5mg/day
• When DHA intake is inadequate sparing mechanism are put into place
  • Increases inflammation
Omega-3 fatty acids

- Aging in animals decreases DHA
- Omega-3 fatty acids protective for Alzheimer's disease
- In animals omega-3 fatty acids play a role in preventing cognitive decline
- The evidence in humans is not clear
Omega-3 and 6 ratio

https://www.youtube.com/watch?v=LGhOoVh0dF0
Carbohydrates

- High glycemic index carbohydrates associated with cognitive decline

- High sugar diet plays a major role in pathogenesis of impaired glucose tolerance and insulin insensitivity

- Brain health reduced with high intake of food increased in sugar and fat content

- BMI, diabetes, hypertension and coronary heart disease adjusted for – diet is responsible for cognitive impairment
Clinical trails

https://www.youtube.com/watch?v=ZPzMhb6uAzQ
Clinical trails

- Occur after a drug has been reported to have benefits in animals, rodents and primates
- Research studies involving human volunteers
- Trials assess safety and effectiveness of new ways to diagnose, prevent or treat disease
Clinical trails

• US Food and Drug Administration trials can be conducted in phases

• Phase 1
  • test potential therapy
  • Number of participants: 10 to 80
  • Safety
  • Determine route of administration (e.g. mouth, injection)
Clinical trails

• Phase 2
  • Safety and effectiveness
  • Large group of people
  • Number of people 100-300

• Phase 3
  • Number of people: 1000-3000
  • Lasts longer
  • Multiple centers
  • Determine whether benefits outweigh the risks
Clinical trials

• Phase 4
  • Drug approved and brought to marker
  • Further safety and effectiveness

• Pharmaceutical drugs compared to nutrients?
Next week how nutrition impacts stroke
Questions?