

Nutrition and cognitive performance

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Overview

- Nutrition and the brain
- Key nutrients for brain function
 - Omega-3 fatty acids
 - B vitamins
 - Antioxidants
- “Brain boosters”: do they work?

Getting nutrients to the brain

- Blood supply brings nutrients to the brain
- 2 sets of major arteries (carotid + vertebral) supply all areas
- Blood-brain barrier regulates inputs and outputs to brain
- Ventricular system carries reservoir of nutrients

Effects of nutrients on the brain

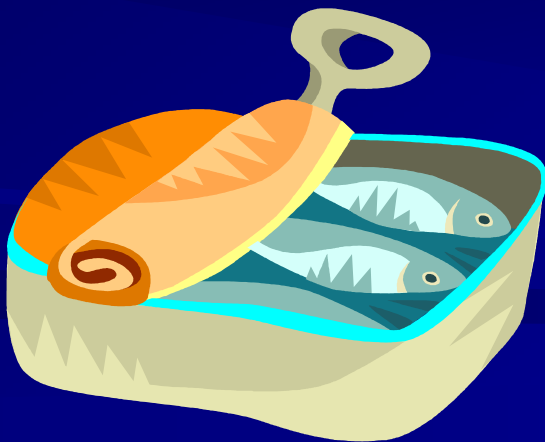
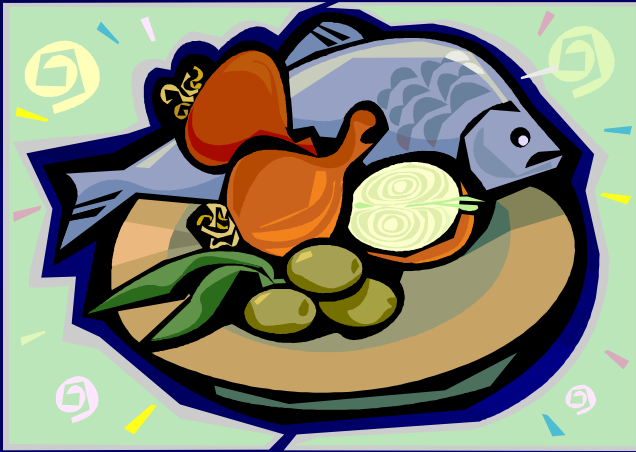
- **Effects on structure:**
neural development
- **Effects on chemistry:**
precursors for neurotransmitters
- **Effects on function:**
provides “energy”, glucose

Key nutrients for brain function

- Omega-3 fatty acids
- B vitamins: folate, vitamin B-12 and vitamin B-6
- Antioxidants: vitamins A, C, E



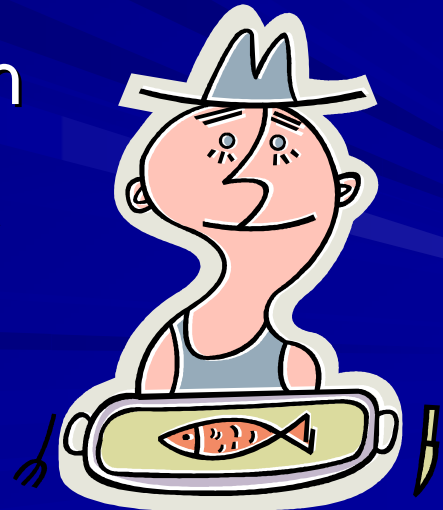
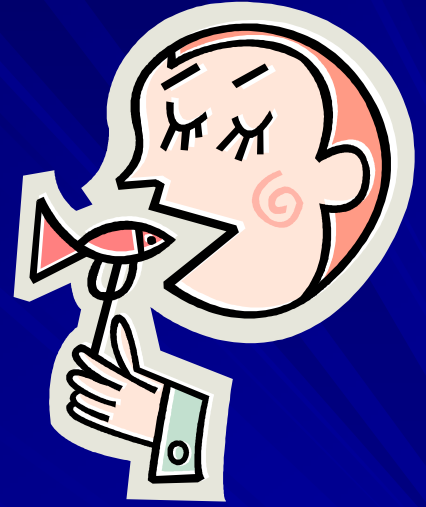
Omega-3 (*n*-3) fatty acids



- Shorter chain *n*-3 fatty acids found in linseed, canola and soybean oils
- Longer chain *n*-3 fatty acids (EPA; DHA) found in fatty fish, human breast milk
- Shorter chain FA can be elongated into longer chain FA but process is slow in humans therefore need to obtain from food
- Compete with *n*-6 fatty acids enzymes. *n*-6 fatty acids readily consumed in vegetable oils
- “Western” diet very low in *n*-3 fatty acids, relatively high in *n*-6

Omega-3 and brain development

- Brain 60% fat content
- DHA one of the major components of neural cell walls
- Increases in long-chain fatty acids thought to increase the efficiency of communication flow in the brain
- Also affects blood vessel integrity and possibly blood flow to the brain



Omega-3 and cognitive performance

- Evidence that n-3 fatty acids are important for brain development in infancy
- Emerging evidence for a positive effect of *n*-3 supplementation on the behaviour and cognitive performance among children with ADHD
- Interest in the possibility that n-3 fatty acids may be important in maintaining cognitive performance in older adults



B vitamins and the brain

- Folate and vitamins B12 and B6 affect the brain by:
 - helping in the synthesis of important brain chemicals
 - Maintaining the health of blood vessels in the brain

Some food sources of B vitamins

- Folate: green leafy vegetables (brussels sprouts, broccoli, spinach), potatoes, bananas, strawberries and legumes.
- B12: meat dairy products and eggs
- B6: cereals, potatoes, bananas, avocado, tuna and salmon, wheat bran

B vitamins and cognition, what we know

- Those who eat more food containing folate and B12 have higher levels of cognitive function and mood
- These seem to be the effect of longer-term dietary habits
- Among those with Alzheimer's disease, those who had higher blood levels of folate showed less decline in certain brain areas
- AD may be associated with a decreasing ability to absorb B vitamins

Short-term supplementation with B vitamins

- We conducted a study in 211 women from 3 age groups: younger (20-30), middle aged (45-55), and older (65-92)
- We gave the women either folate (750 μ g), B-12 (15 μ g), B-6 (75mg) or a placebo daily for 5 weeks
- We tested the women's memory, speed of thinking, planning and decision making and verbal ability and their mood before and after they took the supplements

We found....

- That folate and B12 improved the memory performance of the younger women
- That B6 improved the memory performance of the middle-aged women
- That folate improved the memory performance of older women

Antioxidants and the brain

- The cumulative effects of a lifetime of oxidative damage may damage the brain
- The high content of fat in the brain is susceptible to oxidation
- Limited levels of protective antioxidant compounds in the brain

Antioxidants: vitamins A, C and E

- Vitamin A: orange & red vegetables, apricots, liver, eggs, spinach
- Vitamin C: peppers, kiwi fruit, oranges, strawberries, broccoli, blueberries
- Vitamin E: sunflower seed, almonds, hazelnuts, tomatoes,

Antioxidants and cognition in ageing

- There is some evidence that longer-term intakes of antioxidants (vitamins A and E) may slow down the oxidative changes
- Study conducted in Chicago on 2,889 older adults aged 65-102y from 1993-2000 showed those taking most vitamin E (~258mg/d) from food and/or supplements demonstrated 36% less memory loss than those taking only ~ 4.5mg/d
- Emerging interest in the role of vitamin E in the course of cognitive decline in Alzheimer's disease

“Brain boosters”: do they work?

The candidates:

- Glucose
- Caffeine
- Ginkgo biloba
- Taurine

Glucose and the brain

- The sole source of energy for the brain, utilizing 6.8g/kg per day
- Brain requires constant supply as not able to store
- Required for synthesis of fatty acids and some amino acids

Glucose and cognitive performance

- Reliable findings that 60g glucose is beneficial to the storage and retrieval of memory and concentration in younger and older adults, those with Down's syndrome and AD
- Short-term effects within 2 hours of administration
- High carbohydrate lunches detrimental to reaction time and attention
- Recent work on a range of saccharides suggest an association between higher intake and increased verbal memory performance in middle-aged adults

Caffeine

- Thought to act by increasing general arousal.
- Caffeine has beneficial effects on sustained attention when alertness is low
- Effects on more complex tasks not known
- Effects of caffeine may reflect removal of negative effects of caffeine withdrawal
- Tea consumption may have more sustained effects on cognitive performance and L-theanine in tea may enhance effects of caffeine.

Ginkgo biloba and the brain

- *Ginkgo biloba* is an extract from the leaves of the ginkgo tree
- Many active compounds that have antioxidant, anti-inflammatory and vasoregulatory effects
- Increases blood flow in the brain
- Effects on brain chemicals

Ginkgo and cognition

- Most previous research shows positive effects of ginkgo on cognitive performance in clinical populations, some recent studies do not
- Beneficial effects of short-term ginkgo administration on cognition in younger adults

Ginkgo and cognition in healthy older and younger adults

- We conducted a study among 104 younger adults (18-43y), 93 older adults (55-79y)
- They took either 120mg ginkgo (in 3 doses) per day or placebo for 12 weeks
- They completed a range of tests of cognitive performance and mood before and after treatment

We found.....

- No effects for younger adults
- Improvements in short-term and long-term memory for older adults taking ginkgo

Taurine and the brain

- Widely distributed in animal products
- One of most abundant amino acids in the brain
- Involved in the release of brain chemicals
- Brain levels decline with age

Taurine and cognition

- Animal studies: no beneficial effect on cognition
- Studies in adults show that a beverage containing taurine and caffeine improved fatigue effects during the evening
- An association between spinal fluid levels of taurine and reduced cognitive decline in people with AD

Summary

- Adequate nutrition important for general health and therefore cognitive performance
- B-vitamins and antioxidants may have a beneficial role in cognitive ageing
- “Brain boosters”: glucose, caffeine and ginkgo biloba have some beneficial effects on cognition, weak evidence for taurine.

Thank you

Any questions?