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Food and Cognitive Performance

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Overview

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Effects of foods on mental performance

- What foods affect cognition?
- How do foods affect cognition?
  - Direct effects (magic ingredients)
  - Glucoregulation -short term or long term – IGT/T2DM
  - Hormone effects (e.g. Soy isoflavones/fibre)

Areas of Interest

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- Effects of macronutrients in adults
  - Healthy young students
- Other meals and other groups
  - Change in pattern of eating –large evening meals
  - Preventing/slowing cognitive decline - elderly
  - Increase in obesity -T2DM – IGT
- Other products
  - Novel ingredients, anti-oxidants, isoflavones, flavonoids, vitamins etc

What is Cognitive Performance?

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Perception, understanding & action

Complex tasks – operating machinery, driving, learning, making decisions

Evolved to give us control over the environment

We are all using our cognitive abilities all the time

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The shape of things to come?

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Domains of Cognitive Function

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Perception – attention (vigilance)

Information processing

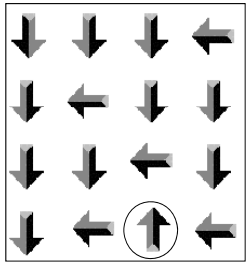
Learning & memory

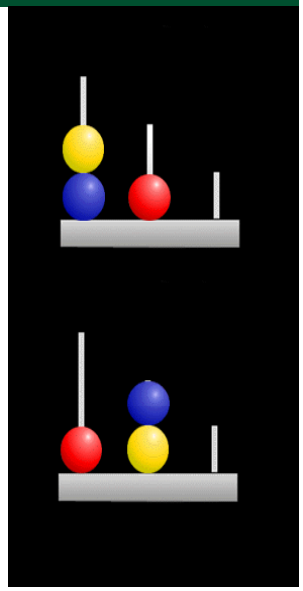
- acquisition
- storage & retrieval
- recall & recognition

Problem solving

Motor control

- reaction time:
- tracking





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Glucose, GI & cognitive function

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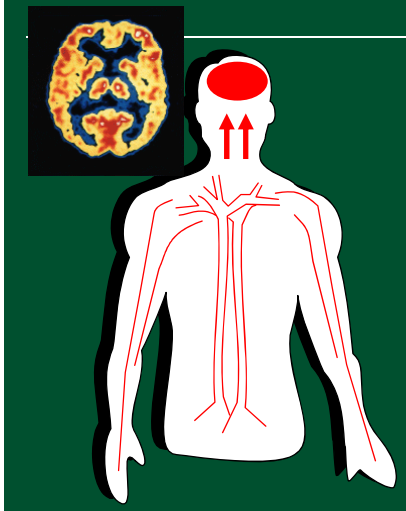
Human Brain: energy



2% of body mass (~3 lb)

- **20% energy (glucose and oxygen)**
- **2-3,000 pints blood/day pass through the brain**

Glucose is main fuel for the brain

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Glucose and cognitive demand

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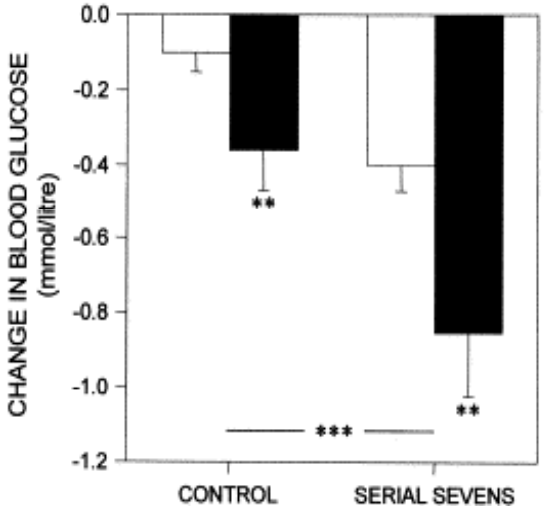

Intense cognitive processing leads to increased neural Glucose utilization

(decrease in peripheral glucose)

Scholey, Harper and Kennedy, 2001

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Glycaemic Index & Cognition

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Between subjects design

Biscuits or cereals

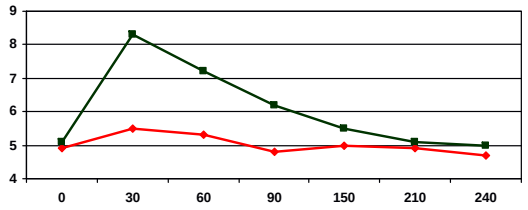
High GI Breakfast (65)

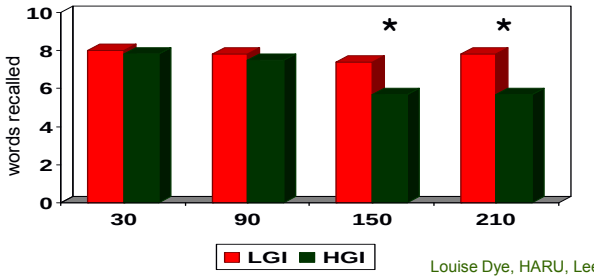
- SAG: 0.1; RAG:42.3

Low GI Breakfast (42)

- SAG: 15.8; RAG:39.5

Verbal memory





Benton et al., 2002

Validation of interstitial glucose against arterialised venous and capillary samples

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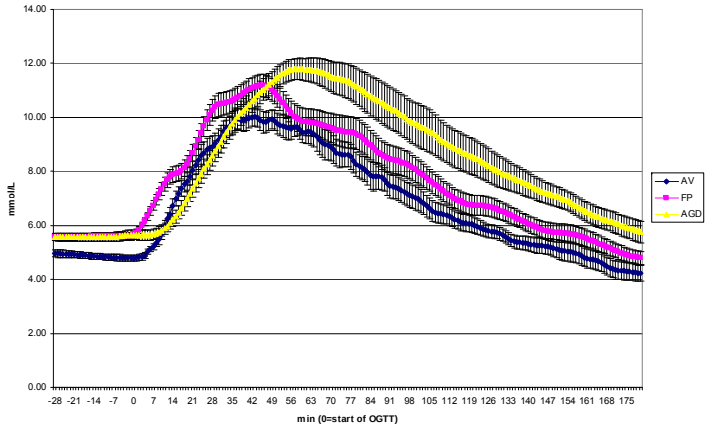

Dye et al, (2009)

Cognition & continuous blood glucose

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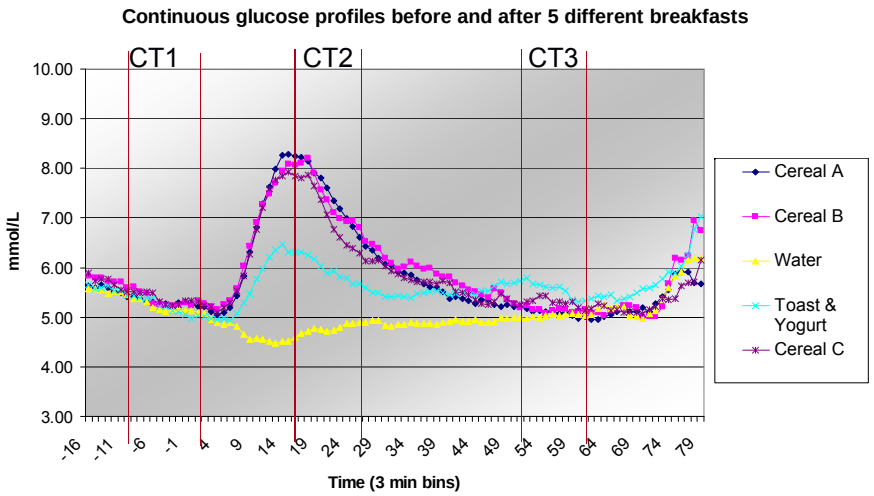

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Immediate verbal recall

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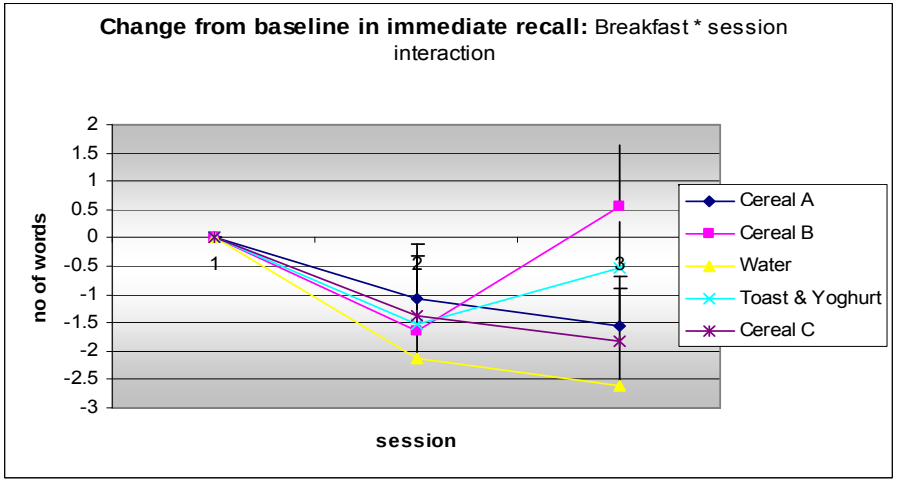

Later in the morning: Cereal B -better recall relative to baseline than water or Cereal C. Toast/Yoghurt better recall than water or Cereal C

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Review

Acute effects of macronutrient manipulations on cognitive test performance in healthy young adults: A systematic research review

Alexa Hoyland*, Clare L. Lawton, Louise Dye

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Acute interventions in young healthy adults

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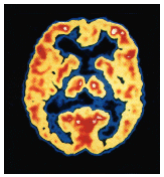

- 31 studies
- 134 cognitive outcome measures
- Manipulations – glucose, macronutrients
- Memory
- High demand situations

- 62 measures showed significant effects

Hoyland et al. (2008)

Delayed Memory is most sensitive to glucose manipulations

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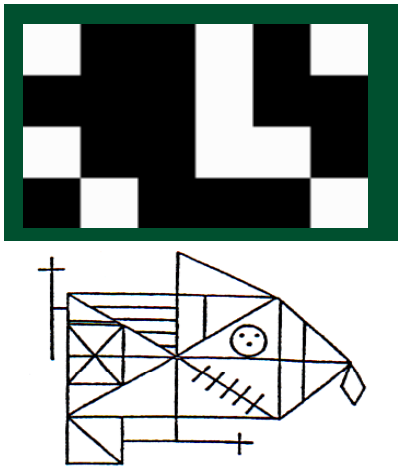
10 studies – 41 measures

Verbal memory (32 measures)

- Free recall
  - Glucose effect in 10/14
- Cued recall
  - Glucose effect in 7/8
- Word recognition
  - Glucose effect in 4/7

Spatial memory (7 measures)

- Glucose facilitation in 4/7



Hoyland et al. (2008)

Conclusions so far…….

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Glucose doesn't always improve cognition

Effects –

- not immediate
- apparent when blood glucose levels are similar
- not GI dependent
- Glycaemic response & cascade of events

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Effects of Meals

Breakfast

Lunch & the Post Lunch Dip

Meals, macronutrients and mental performance

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Meal	RT	Memory	Attention
Breakfast			
Adults	*	***	
Children	*	*	*
Lunch	***		***
Evening Meal	?	?	?

Dye and Blundell, 2002

Post Lunch Dip

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30 EXPRESSWOMAN Tuesday October 15 2002 Daily Express

Beat afternoon apathy

A new survey among 1,000 British office workers found many suffer from 'afternoon apathy', a severe after-lunch energy slump that affects brain power, output and memory. PETA BEE investigates

Picture: GETTY IMAGES

DESKBOUND: Poor diet and lifestyle can lead to lethargy after lunch

LIFESTYLE is almost certainly to blame for afternoon apathy, a condition estimated to cost the British economy £3.9billion a year and cause efficiency to drop by 10 per cent.

In research carried out for Ryvita, more than half the women and more than a third of the men questioned admitted suffering from the syndrome, which is thought to affect around 12million employees.

"Most Britons eat stodgy lunches that leave them feeling lethargic," says nutritionist Fiona Hunter. "People think high-carbohydrate foods boost energy but they have the opposite effect, so you are energy-sapped when you return to work." Here's how to avoid afternoon apathy.

hummus or peanut butter are great energy boosters," says Fiona. Three

breathing exercises or a brisk walk is ideal. A 10-minute walk leaves you

British School of Complementary Therapy, recommends peppermint

activity but don't overdo it as six cups or more will leave you flagging.

FAD OF THE WEEK

Pzizz Powernapping Tool

MILLIONS suffer from afternoon apathy syndrome but scientists reckon a short nap after lunch can improve memory and concentration, reduce stress and boost productivity.

So if you find it difficult to switch off and even harder to wake up, a gadget called the Pzizz may be your saviour. It looks like a small MP3 player and plays random sound effects to induce a relaxed state.

You can programme it to run for up to an hour – which was as long as I could stand listening to its annoying American voiceover.

The only time it really worked for me was at home in bed. I fell asleep a few minutes into the programme so I'm not sure if I derived any benefit. But I woke as soon as it finished and I definitely did not feel as tired afterwards. Shame I wasn't going out.

● *Pzizz costs £24.7 including p&p and comes with a 30-day money-back guarantee. Details: 0800 781 2507/ www.pzizz.com*

LAURA MILNE

eds

Effect of high & low GI at lunch on Post Lunch Dip

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3 meals

cognitive performance, subjective state & appetite in relation to the post-lunch dip

- A – HGI – CHO
- B – LGI – CHO
- C – HGI - HP

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Blood glucose after each meal does not relate to mental performance

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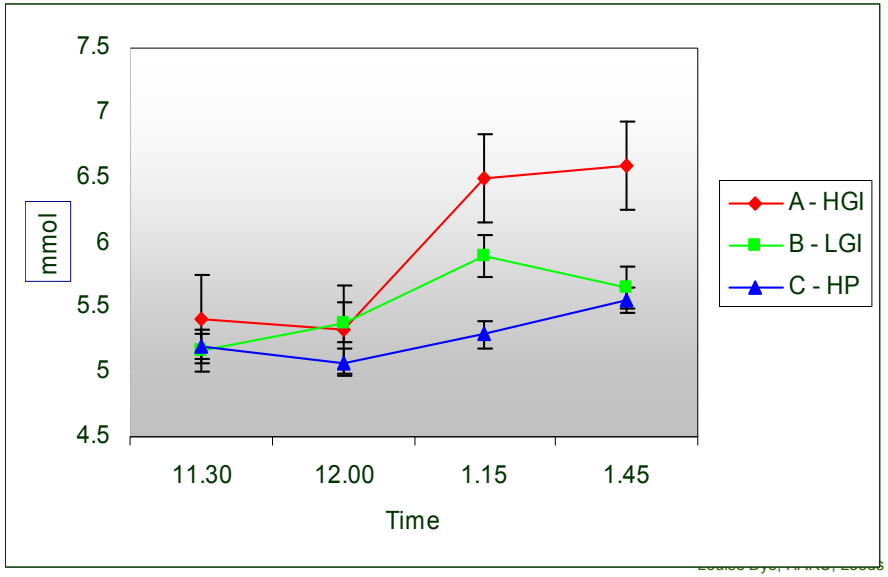

Blood glucose after HGI & LGI meals alters experience of the Post Lunch Dip

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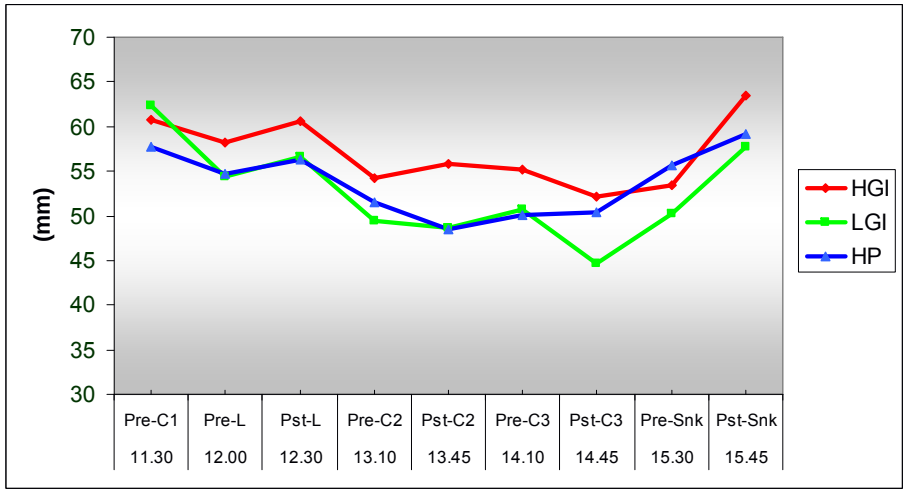
Mental alertness after HGI-CHO, LGI-CHO & HP meals



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Effects in children

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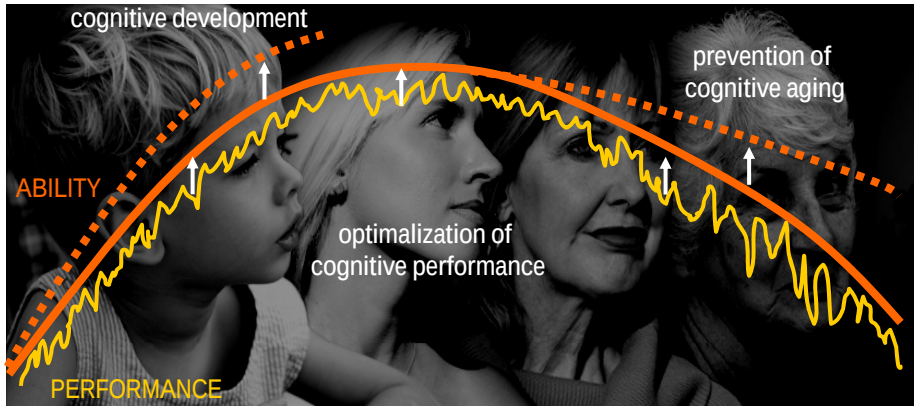

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Nutrition for the Growing Brain
Basic needs

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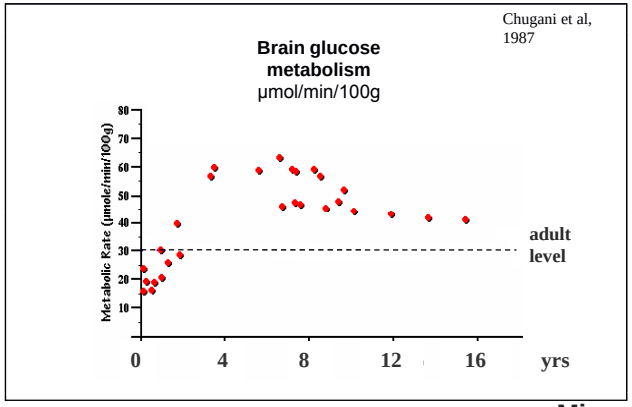

A developing child's brain uses 200-300% more energy than that of an adult.

Nutrition should provide **adequate glucose sources** to meet these high demands.

Micro-nutrients such as Iron, Zinc, Iodine and B-vitamins are required for key metabolic and control processes in brain development.

Breakfast and cognition in children

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Systematic review

Two aims:

- Does breakfast per se confer benefits?
- Is breakfast type important?

- 45 studies

Category	Number of studies
Acute effects in well-nourished children	21
Acute effects in children of differing nutritional status	7
Long-term effects of school breakfast programs and breakfast clubs	13
Effects of habitual breakfast intake	4

Hoyland, Dye & Lawton (Nutr. Res. Reviews 2009)

Review findings

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- Few studies
- Generally +ve effects of BF
- Small effects
- Difficult to determine optimal breakfast

- **Most convincing effects for school breakfast programs**
  - but these increased school attendance
- **More demonstrable in nutritionally vulnerable children**

- Predominance of younger samples or large age range
- Poor range of cognitive tests

-concentration on memory and attention performance

Hoyland, Dye & Lawton (Nutr. Res. Reviews 2009)

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Breakfast vs No Breakfast

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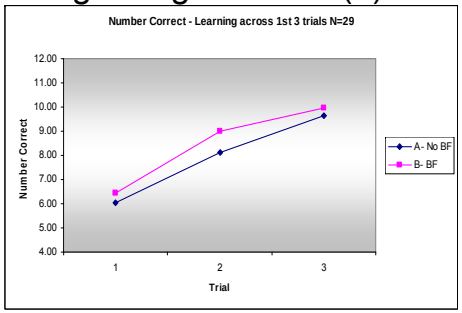
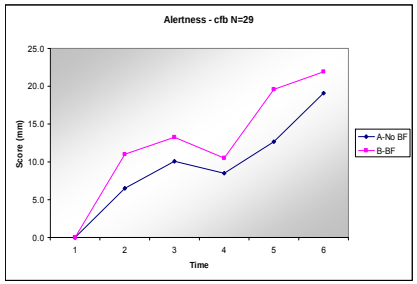
- BF vs No BF
- 29 children aged 11-12years
- IQ controlled for
- Large range of tests (9)





Benefit of BF for psychomotor performance & memory

Higher IQ protective

Dye, Hoyland & Lawton (in prep)

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Effects in the elderly

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Epidemiological studies: dietary intake & cognitive function

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Dietary component	Cognitive impairment risk
Fatty Fish	↓
Omega 3 PUFA	↓
Cholesterol	↑
Sat Fat	↑
Homocysteine	↑

•Rotterdam Study - 45-70 year old (Kalmijn et al., 2004)

Fish consumption is negatively related to the risk of dementia

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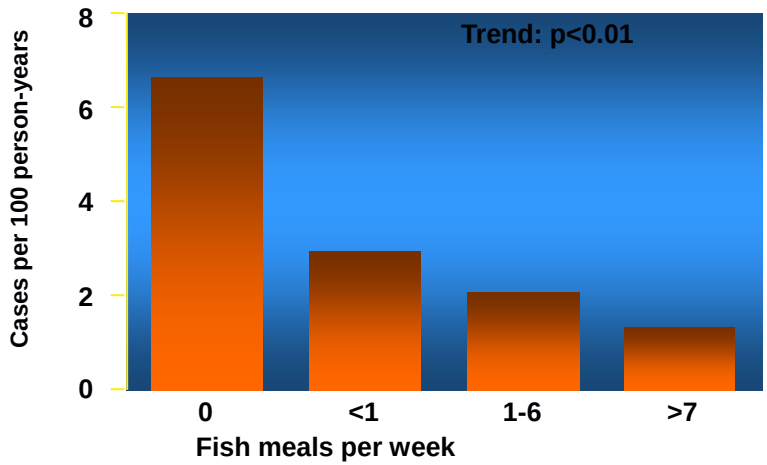

(Barberger-Gateau, 2002)

Mechanism of Action

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Ingested Dietary component

Physiological change in central process

Cognitive Function

Improved Health e.g. Reduced BP, Obesity, improved Glycaemic control

Known?

Biomarkers – potential vs known Time course of action

Age/gender dependent effects - soy IF

Effects of glucose on cognition in relation to glucose regulation

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Epidemiological studies of IGT–clear association with impaired cognitive function (Kalmijn et al., 1995)

Systematic review

NGT –

Normal glucose tolerance

Clear effects on cognition

Memory –worse

- specific tests

Only in poor regulators in the normal range

IGT –

Impaired glucose tolerance

Pre Diabetic state – losing regulation

Unaware, not on treatment

Middle aged

Few effects on cognition

Poor range of insensitive tests (e.g. MMSE)

Lamport et al., *Neuroscience & Biobehav. Reviews* (2009)

Dietary fibre, exercise & cognition in elderly with IGT /T2DM

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•2 year intervention: exercise 2-4/wk + Dietary fibre >30g/day

	NGT (n=74)	IGT (n=36)	T2DM (n=19)
FPG	0	-	-
2hr OGTT	0	-	-
HOMA	0	-	-
MMSE	0	0	+
Dementia scale	0	0	+
Delayed recall	0	+	+
Block design	0	+	0

Dietary fibre & exercise improved cognitive function via improved glucoregulation

•Yamamoto et al., 2009

Soy – naturally high in fibre

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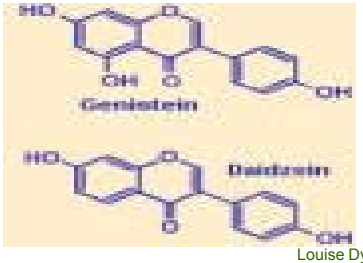
Plant

Produce

Structure



Habitual Soy consumption & cognitive function

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- Dementia – lower in Japan

- Honolulu Asia Aging Study- cross-sectional
  males 71-93yrs
  Tofu - poorer cognitive function
  1% variance in cognitive function explained
- Kame project - longitudinal
  - Rate of cognitive decline not related to tofu consumption
- SWAN – cross-sectional
  IF consumption not correlated with cognitive function

Soy effects

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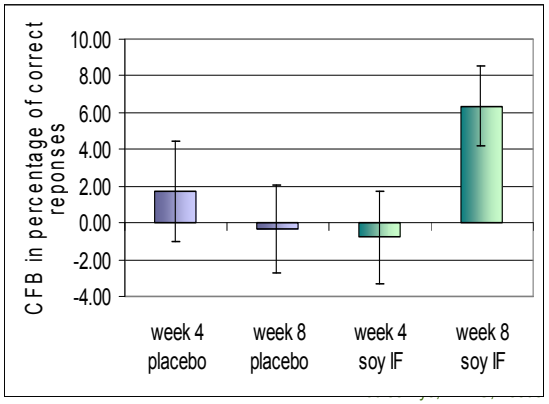
Naturally high in fibre
Effects on satiety
Positive effects of glucoregulation
Effects on symptoms
Effect on cognitive function

Mechanisms:
Phytoestrogens
+
High fibre

Hill et al., submitted

Effect of IF on Planning Ability



Novel foods/ingredients

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Lots of interest in:

- Blueberries
- Isomaltulose
- Gingko biloba
- Ginseng
- Flavonoids
- Soy
- Curcumin
- Goji berry
- Red wine!!





And many others…….

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Blueberry Supplements reverse deleterious effects of ageing on motor behaviour

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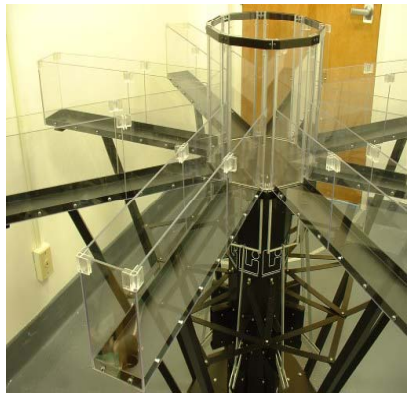
prevent behavioural deficits in mice
-antioxidant effect
(Joseph et al., 2003)



Reading study - first in humans
Acute -no effects

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Rats are not little humans & humans are not big rats

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Dissemination - Media & Public understanding

eeds

A recent Cochrane review does not support a preventive role of n-3 PUFA in cognitive impairment or dementia

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THE COCHRANE COLLABORATION®

"There is no evidence that dietary or supplemental omega 3 polyunsaturated fatty acid (PUFA) reduces the risk of cognitive impairment or dementia in healthy elderly persons without pre-existing dementia."

Lim WS, Gammack JK, Van Niekerk JK, Dangour AD. Omega 3 fatty acid for the prevention of dementia. Cochrane Database of Systematic Reviews 2006, Issue 1. Art. No.: CD005379. DOI: 10.1002/14651858.CD005379.pub2

Future Directions

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- Changing nature of diet, health & population
  - Understand effects of altered eating patterns
  - Effects of under & overnutrition
- Cognitive benefits could be conferred directly –specific nutrients or overall intake
- Or via other effects on health e.g. better gluco-regulation, reduced triglycerides or other markers
- Important to preserve cognitive capacity in ageing

Thank You!

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BioPsychology Group

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