Food for Thought: Exam Time Nutrition

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Outline

• Basic Metabolism & Brain Function
• Cognition & Macronutrients
  • Carbohydrate, fat
  • Macronutrient manipulations
• Cognition & Hydration
• Cognition & Specific Nutrients
• Cognition & Other Habits
• Exam Nutrition
  • Practical tips, meal ideas, snack ideas
• Questions
Overview of basic metabolism, brain function

• Your brain needs fuel!

• 2% of total body weight, but 20% of our energy needs

• Energy is needed for:
  • Neurotransmitter synthesis & action
  • Neuronal computation & information processing
  • Foundations for learning & memory

• Your brain needs carbohydrate (CHO)

• Glucose is only usable source of energy
  • Can be produced from alternate forms of energy (fat, protein) if needed

https://www.arcticapples.com/feed-your-brain
What should I eat in order to perform well on my exams?

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<tr>
<th>Cognition</th>
<th>Nutrition</th>
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<tr>
<td>• What is cognition?</td>
<td>• Single nutrient versus whole food</td>
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<td>• Attention, perception, reasoning, planning,</td>
<td>• Single food versus dietary pattern</td>
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<td>perception, planning, problem solving,</td>
<td>• Nutritional status?</td>
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<td>decision making, language, multitasking</td>
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Macronutrients: Carbohydrate

- Glucose is the only usable metabolic fuel for the brain
- \( \uparrow \) cognitive demand = \( \uparrow \) glucose metabolism in the brain
- Hypoglycemia: low blood glucose
- Hypoglycemia negatively affects mental performance
  - Visual, auditory processing
- Response to hypoglycemia affected by several variables:
  - Sex, previous hypoglycemic episodes, hypoglycemic unawareness, IQ
- Threshold of cognitive impairment 2.2-2.8 mmol/L

https://www.everydayhealth.com/weight/why-carbohydrates-are-important-for-your-diet.aspx
Macronutrients: Fat

• Saturated – ex. animal fat, butter, cheese, milk, coconut oil, palm oil
• Unsaturated
  • Monounsaturated – Olive, canola, peanut, safflower, sesame oils; almonds, pecans, cashews, avocado
  • Polyunsaturated – salmon, mackerel, sardines, flaxseed, walnuts, soybean oil, canola oil
• Diets higher in saturated fats may increase inflammation in the brain
  • Impairment of signal transmission in the brain
• Type of fat in diet may impact learning acquisition
  • Saturated versus unsaturated
  • Performance of variable (interval delayed) alteration task worsened with higher saturated fat intake
• BUT.....
CECIL COULDN'T FATHOM WHY THEY DECIDED THEIR DIETARY HABITS BY WATCHING HIM EATING DRY PELLETS.

Macronutrient Manipulations: Carbohydrate & Protein

- High Carbohydrate meals versus high protein meals
  - ↑ CHO meals produce greater drowsiness, sleepiness, calmness
  - Slower reaction time, impaired attention after high CHO meals
  - High protein meals produce susceptibility to distraction, slower memory scanning
- Since CHO & protein have different effects on cognitive tasks, they are likely important for different cognitive processes
- Effect of stress in macronutrient manipulations
  - Alterations in availability of tryptophan and brain serotonin concentrations
  - Improvement of memory scanning task in stress prone subjects when fed CHO rich, protein poor diet compared with CHO poor, protein rich
Macronutrient Manipulations: Carbohydrate & Fat

- Inconsistencies in methodology, outcomes
- Small sample sizes, insufficient power
- High fat lunch produce slower reaction time
  - But more accurate performance on selective-attention tasks
- High fat, low CHO versus low fat, high CHO versus medium fat, medium CHO
  - Reaction time was slower with high fat, low CHO and low fat, high CHO compared to medium fat/CHO
- Higher than usual CHO or fat may cause ↑drowsiness, uncertainty, muddled thoughts
Meal Timing & Novelty

• Effect of macronutrients may be mediated by time of ingestion, also in relation to time of testing
• Cognitive performance improves until midday, then declines
• Breakfast
  • Improvement with consumption (word recall, spatial memory)
  • Effect of caffeine
• Lunch
  • Most studies show a decline in performance (perceptual discrimination vigilance)
• Snacks
  • AM & PM snacks show varying results on cognitive performance
• Dinner
  • Limited data, since most work happens during the day (except for students!)
• Novelty of meal
Macronutrients: Take home messages?

• Eating a variety of foods is important
• Everyone is different
• Generally, people need to eat every 4-6 hours
• Listen to your body
• Following habitual intake on exam day or studying for exams may be best

https://studybreaks.com/college/eat-2
Hydration & Cognitive Performance

• One of the most important aspects of nutrition to protect cognitive functioning
• Changes in electrolytes can alter neurotransmitter functioning
• Compromise blood flow to brain
• Attention, psychomotor, immediate memory skills
• Cognitive compensation through increasing subjective task effort
• 2% loss in hydration status can lead to impaired cognitive functioning
  • More pronounced in women than men

https://www.hawaiipacifichealth.org/healthier-hawaii/live-healthy/drink-up-the-importance-of-hydration/
Am I well hydrated?

- Colour of urine
- Other symptoms: thirst, dry lips, flushed skin, tiredness, headache, dizziness, etc
- Recommendations
  - Men: 3.7 L/d
  - Women: 2.7 L/d
  - 30-35 ml/kg body weight  Best food & drink sources for hydration
- Sources of water
  - Water & other beverages, fruits, vegetables
  - Sports drinks generally are not necessary
- Caffeine does not have a diuretic effect*

https://mcgregorfast.com/fitness/hydration-status-measured-2/
Specific Nutrients & Cognition
Specific Nutrients & Cognition: Omega-3 Fatty Acids

- Various forms found in food, synthesized in body
  - ALA → DHA, EPA
- ALA requirement
  - 1.6 g/d males; 1.1 g/d females
  - 1 tbsp. chia seeds: 1.9 g
  - 1 tbsp. flaxseeds (ground) 2.43 g
- DHA, EPA no requirement set
  - Cold water fatty fish, algae, fortified foods, supplements
- Highly researched in health, disease prevention & management
  - Cancer
  - Heart disease
  - Depression
  - Aging
  - MANY MORE!

https://oceanblueomega.com/how-to-balance-your-omega-6-to-omega-3-ratio/
Specific Nutrients & Cognition: Omega-3 Fatty Acids

- Lots of research, but...
  - Neurodegeneration, school aged children
- Observational studies
  - Associations between cognitive performance & fatty acid status
  - Mixed results
  - Contribution of n-3 to cognitive performance seems to be more important in females
- Intervention studies
  - Provision of n-3 as DHA capsules
  - Mixed results: some improvement, or no benefit
  - Men: improved reaction time of working memory
  - Women: improved accuracy of episodic memory
- Differences in results: dose used, DHA vs EPA?, dietary history of n-3 intake, relevance of cognitive tests

https://vancouverbia.org/omega-3-fatty-acid-intake-treatment-traumatic-brain-injury/
Specific Nutrients & Cognition: Iron

- Most well known for role in transporting oxygen to cells
- Men 19 & older: 8 mg/d
- Women 19-50: 18 mg/d
  - Upper limit: 45 g/d
- Vegetarians*
  - Heme iron (animal sources)- meat, fish, poultry; more easily absorbed
  - Non-heme iron (plant sources)- dried beans, peas, lentils, some fruits & vegetables; less easily absorbed
- Inadequate dietary intake can lead to iron deficiency, or iron deficiency anemia

Specific Nutrients & Cognition: Iron

- Iron deficiency may disrupt metabolic processes, change cognitive/behavior functioning
- Women of reproductive age particularly susceptible to deficiency
- Intervention study:
  - Women 18-35 y/o of varied iron status
  - Assigned to Iron or placebo x 4 mo
  - Improvement in iron status associated with 5-7 fold improvement in cognitive performance

http://www.diagnosisdiet.com/micronutrients-mental-health/brain-needs-iron/
Specific Nutrients & Cognition: Caffeine

- Naturally occurring in food/drink
- Additive to food, drink, or supplements
- Increases wakefulness, mental alertness, cognitive functioning
- Negative effects on withdrawal, or excess consumption
- Differences in individual sensitivity
- Health Canada Recommendations:
  - Men & Women > 19 y/o: 400 mg/d
  - Pregnant/breastfeeding women > 19: 300 mg/d
- *Most serving sizes of coffee, energy drinks are greater than 250 ml
  - Large coffee ~ 450 ml
  - Monster Energy Drink 480 ml

<table>
<thead>
<tr>
<th>Food</th>
<th>Serving Size</th>
<th>Caffeine (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coffee, brewed</td>
<td>250 ml (1 cup)*</td>
<td>100-170 mg</td>
</tr>
<tr>
<td>Espresso</td>
<td>30 ml (1 oz)</td>
<td>43-90 mg</td>
</tr>
<tr>
<td>Tea (black)</td>
<td>250 ml (1 cup)*</td>
<td>43-80 mg</td>
</tr>
<tr>
<td>Energy drink, various</td>
<td>250 ml (1 cup)*</td>
<td>80-100 mg</td>
</tr>
<tr>
<td>Diet cola</td>
<td>355 ml (1 can)</td>
<td>25-43 mg</td>
</tr>
<tr>
<td>Chocolate, dark</td>
<td>40 g</td>
<td>27 mg</td>
</tr>
<tr>
<td>Caffeine pills</td>
<td>1 serving</td>
<td>100-200 mg</td>
</tr>
</tbody>
</table>
Specific Nutrients & Cognition: Caffeine

• Low to moderate doses improve cognition (40-300 mg)
• Lower cognitive functions are improved - e.g., reaction time
• Higher cognitive functions - e.g., problem solving, decision making are debated
• Effects on cognition follow a U-shaped curve
  • Low arousal associated with poor performance, increased mental arousal associated with improved performance but only to a point
• Caffeine consumers (average ~400 mg/d) exposed to long term or acute caffeine withdrawal
  • Cognitive testing in state of ‘sleep restriction’ with placebo or caffeine administration
  • Acute caffeine withdrawal had a number of negative effects - impairment of cognitive performance, increased headache, reduced alertness & clear-headedness
  • Caffeine administration following acute withdrawal prevented further decline in cognitive performance
• Caffeine administration after long term withdrawal did not improve cognitive performance
• If you are consuming caffeine regularly, don’t stop right before an exam!
• Effect of caffeine on cognition is relatively well established, less is known regarding effect when administered with other components (e.g., energy drinks)
Cognitive Performance & Other Health Habits: Exercise

• Reports that brief bouts of exercise improve mood, psychological well being, and ability to think clearly

• General improvement of cognitive performance following exercise

• Submaximal aerobic exercise performed for periods up to 60 minutes facilitate specific aspects of information processing

• May be more energizing than caffeine in young women with chronic insufficient sleep
  • 10 minutes of stair walking versus 50 mg caffeine versus placebo
  • No difference in aspects of cognitive performance, but does have transient energizing effect

http://www.bewegenvoorjebrein.nl/page/2/
Cognitive Performance & Other Health: Sleep

- Sleep is becoming a more studied variable in several aspects of health and disease
- Regular and long timer disruptions in circadian rhythm can increase risk of disease
- Sleep of university students can be variable in duration & timing
- Consistently low sleep duration associated with cognitive impairments
  - Increased reaction times, reduced cognitive throughput
- Misalignment of circadian rhythms may also impair cognitive performance
- Sleep regularity is positively associated with academic performance

So....back to our original question:

What should I eat in order to perform well on my exams?
A Guide for Food Choices

- Most people need to eat every 4-6 hrs
- Include a combination of carbohydrate, fat, and protein
- Make sure you are well hydrated
- Include Iron rich foods
- Consume caffeine as per usual intake (if applicable)
- Don’t change what you are currently eating drastically
- Eatwell Plate

http://www.hypertensiontalk.com/new-healthy-eating-tools/
General Tips

• Making sure you have good eating habits is like studying for exams - don’t wait until the last minute to start
• Make sure you freezer & pantry is well stocked before exam time
  • Will make grocery store trips faster
• Batch cooking
• Have a plan for the day, and time meals & snacks accordingly
  • Most people need to eat meals every 4-6 hrs (beyond this may need to snack)
• Listen to you hunger cues
  • Very normal to use food to soothe in times of stress
  • Get away from books & computer while eating, if you can
  • Other ways to relieve stress
Exam Meal Ideas - Breakfast

- Banana, tortilla, nut butter**
- Instant oatmeal*, walnuts**, raisins
- Cold cereal*, milk (or alt), banana, hempseeds**
- English muffin, egg*, tomato slices
- Yogurt, granola*, frozen berries, chia seeds**
- Scrambled eggs*, cheese, tortilla, salsa
- Granola bar, banana
- Smoothie (frozen banana, ground flaxseed**, cocoa powder, milk or alt)
- Bagel with hummus*, tomato slices
- Leftover quinoa, milk, banana, nuts**
- Trail mix* (**) & apple

**Good source of N-3; *Good source of iron
Exam Meal Ideas- Lunch/Dinner

- Leftovers!
- Sandwich + fruit
  - Meat (or tofu, smashed beans, hummus, etc)*, lettuce, tomato cucumber, mustard, bread or pita
- Scrambled eggs, peppers, spinach*, cheese, toast
- Pizza: premade shell or pita w/ cheese, spinach*, fried egg*, pasta sauce
- Burrito bowls: black beans*, rice, tomato salsa (tomato, green onion, cilantro, lime juice, S&P)
- Stir-fry: rice or noodles, tofu (or meat)*, frozen broccoli* sautéed with soy sauce, ginger, garlic, chilies
- Lentil stew (onions, carrot, kale*, ginger, garlic, red lentils*, coconut milk, tomato paste, spices, water)
- Chili: +/- ground beef, beans, canned tomatoes, green peppers, frozen corn, spices
- Instant ramen: add frozen veggies, edamame* soft boiled egg*, soy sauce/miso paste
- Salad: Kale*, quinoa, leftover salmon**, roasted beets, ginger vinaigrette

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Exam snack ideas

- Try incorporating protein and a carbohydrate (and/or veggies)
  - Carbohydrate:
    - crackers, fruit, bread/pita bread, granola, popcorn, instant oatmeal etc
  - Protein:
    - nuts, nut butters, hummus, canned tuna, yogurt, tzatziki, boiled eggs, etc
  - Veggies
    - Cucumber, carrot, celery, cherry tomatoes, bell peppers

- Snack ideas:
  - Trail mix (nuts** & dried fruit)
  - Frozen berries & Greek yogurt
  - Slice of toast with nut butter**
  - Homemade muffin
  - Fresh veggies & hummus* or tzatziki
  - Cheese & crackers
  - Guacamole & tortilla chips
  - Hard boiled egg* & fruit
  - Canned tuna & crackers
  - Granola bar

**Good source of N-3; *Good source of iron
References


References Cont’d


Thank you!

https://ueat.utoronto.ca/a-chronicle-of-brain-foods/