Gut Health and Grains
Dr Joanna McMillan

Body Weight and Breakfast
Dr Flavia Fayet-Moore

Monday 23rd September 2019

Supported by the Australian Breakfast Cereal Manufacturers Forum (ABCMF)
INTRODUCTION

• The gut microbiome is a hot topic & emerging evidence links to a human physical & mental health
• Whole grains and cereal fibre associated with ↓risk chronic diseases including some cancers, type 2 diabetes, obesity & CVD – why?
• This report uncovers the evidence and explores the involvement of the microbiome
• Explores the role of breakfast cereals, being a major source of wholegrains and cereal fibre for Australians
• What advice should we be giving to boost microbiome health?

ANATOMY OF A GRAIN
DEFINITIONS

• Whole grain: The intact grain or the dehulled, ground, milled, cracked or flaked grain where the constituents – endosperm, germ and bran – are present in such proportions that represent the typical ratio of those fractions occurring in the whole cereal and includes wholemeal.

• Cereal fibre: These are specific fibres found in whole grains/cereals. They are almost all located in the outer layers of the grain that are collectively called the bran. The bran can be removed from the grain and added to food products, as part of the manufacturing process, to increase the fibre of foods such as breakfast cereals and breads. E.g. Wheat bran and oat bran

HEALTH EFFECTS OF DIETARY RISKS IN 195 COUNTRIES

Lancet 2019;393:1958-72
HEALTH EFFECTS OF DIETARY RISKS IN 195 COUNTRIES

DALY = disability-adjusted life year

Lancet 2019;393:1958-72

HOW MUCH ARE AUSTRALIANS EATING?

• Not enough!
• 70% fail to meet the recommended whole grain intake of 48g/d – median intake 21g/d
• Children recommended 32-40g/d – median intake 16g/d
• For cereal fibre median intake for adults 6.4g and children/adolescents 6.2g
FIBRES PRESENT IN WHOLE GRAINS

• Non-starch polysaccharides (NSP) – arabinoxylan, β-glucan, cellulose
• Resistant starch (RS)
• Oligosaccharides – fructans, fructo-oligosaccharides (FOS), galacto-oligosaccharides (GOS)
• Lignin & lignans

[Graph showing fibre composition of common whole grains]
PHYTOCHEMICALS IN WHOLE GRAINS

- Polyphenols – benzoic & cinnamic acids, esp. ferulic acid
- Plant sterols
- Tocols (vit E – major fat soluble antioxidants)
- Betaine (osmolyte to protect cells under stress & methyl donor, participates in the methionine cycle)
THE MICROBIOME

Unique to the individual—established in early life and shaped by genetics, environment, diet & lifestyle

Diet is responsible for around 57% of variation—huge potential therefore for using diet to instigate beneficial changes

Functional and compositional changes in microbiome associated with type 2 diabetes, overweight & obesity, CVD, inflammatory bowel disease, autoimmune diseases and inflammatory skin diseases such as psoriasis

Increasing interest on the gut-brain links influencing depression, anxiety & long term brain health

WHAT DOES THE MICROBIOME DO?

- Helps to digest food components our own enzymes can’t break down
- Produces some micronutrients
- Keeps colonic cells healthy & maintains an intact, healthy mucosal layer
- Produces metabolites that travel throughout the body influencing physical & mental health
- Intimately involved with immune system—‘trains’ it in early life
ROLE OF DIFFERENT FIBRES

- MACs = microbiota-accessible carbohydrates – fermentable fibres
- RS and most soluble fibres are fermentable
- Some insoluble fibres are fermentable
- Insoluble fibres importantly carry MACs through length of colon ensuring fermentation takes place right to the distal sections where most cancers occur
- Insoluble fibres have the highest phenolic content and the greatest antioxidant capacity

GRAIN PHYTOCHEMICALS & THE MICROBIOME

- 90% of the phenolics in grains are bound to fibres in the bran layer
- Released by the microbiota
- Modulate microbiota composition, boosting the growth of beneficial species
- Some directly absorbed into bloodstream
- Others metabolised into more biologically active and better absorbed metabolites
MAJOR PHYTOCHEMICALS

• Ferulic acid – wheat, wheat bran, rye & corn
  • Released along the length of colon = elevated in the blood for up to 24 hrs giving long lasting antioxidation protection
  • Cf ferulic acid from fruits & coffee increase blood levels for only ½-3 hrs

• Avenanthramides – unique to oats
  • Topically these have anti-itch & anti-inflammatory effects (hence oatmeal bathing products)
  • Orally these are released on fermentation & have effects locally within the colon & systemically once absorbed – reduce inflammation & oxidative stress

THE GUT – GRAIN CONNECTION
ROLE OF BREAKFAST CEREALS

• Of the 88% of Australian adults who eat breakfast, almost half have breakfast cereal
• Those who do have healthier diets overall
• 40% of whole grains in Aus diets come from breakfast cereals
• Breakfast cereals & porridge provide 28.8% cereal fibre adults, 21.7% for children
• 70% of breakfast cereals available in Aus are whole grain

BREAKFAST CEREAL & THE MICROBIOME

• 39/42 studies in systematic review found increased microbial diversity and/or abundance with regular cereal fibre consumption
• A daily bowl of a high fibre breakfast cereal had positive effect on microbiome within 3 weeks & benefits observed for at least a year
• Whole grain corn, wheat & oat breakfast cereals/ granola have been shown to ↑ Bifidobacterium and/or lactobacilli
• Whole grain breakfast cereals shown to increase blood ferulic acid & reduce inflammatory markers
• Variety in whole grains may be key
DIETARY RECOMMENDATIONS FOR A HEALTHY GUT MICROBIOME

• Emphasise plant-rich diet – this can also include animal foods
• Diversity of plant foods = diversity of fibres & phytonutrients = diversity of microbiota
• Choose whole grains and foods high in cereal fibre daily – breakfast cereal, muesli, granola or porridge are convenient, easy & budget friendly breakfast options
• Include legumes 2-3 times a week
• Daily handful of nuts
• Variety of vegies & fruit
Why do adults who eat breakfast cereal have healthier diets & more favourable weight status?

A secondary analysis of the 2011-12 National Nutrition and Physical Activity Survey

Flavia Fayet-Moore
PhD, MNutrDiet, APD, RNutr, FASLM

23 September 2019
USING AUSTRALIAN ADULT DATA

Not just **breakfast**
- Rest of the day

Not just **nutrients**
- Five Food groups & discretionary foods & beverages

Fayet-Moore F et al. Breakfast choice is associated with nutrient, food group and discretionary intakes in Australian adults at both breakfast and the rest of the day. *Nutrients* 2019; 11(1).

### METHODS

2011-12 NNPAS (n = 9341 adults 19+ years)

3 BREAKFAST GROUPS

- **Skipper**
- **Non Cereal**
- **Breakfast Cereal**
ANALYSIS

Consumer characteristics
Weight status
Types of foods consumed
Five Food groups
Discretionary intakes
Nutrient intakes

CONSUMER CHARACTERISTICS
BREAKFAST CEREAL EATERS HAD A DISTINCT SOCIO-DEMOGRAPHIC PROFILE

<table>
<thead>
<tr>
<th>SKIPPERS</th>
<th>NON CEREAL</th>
<th>BREAKFAST CEREAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>12%</td>
<td>47%</td>
<td>41%</td>
</tr>
<tr>
<td>More males</td>
<td>More females</td>
<td>More males</td>
</tr>
<tr>
<td>Youngest</td>
<td></td>
<td>Oldest</td>
</tr>
<tr>
<td>Lowest SES</td>
<td></td>
<td>Highest SES</td>
</tr>
<tr>
<td>More inactive</td>
<td></td>
<td>Less inactive</td>
</tr>
</tbody>
</table>

DID TYPE OF BREAKFAST INFLUENCE WEIGHT STATUS?

BREAKFAST CEREAL CONSUMERS HAD THE LOWEST BMI & WAIST CIRCUMFERENCE

Different superscript (a,b) denotes significant difference (p < 0.001)
WHAT’S FOR BREAKFAST?

FOODS & CEREAL CONSUMED

% of consumers of food groups at breakfast

<table>
<thead>
<tr>
<th>NON CEREAL</th>
<th>BREAKFAST CEREAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>52% Bread</td>
<td>82% RTE cereal</td>
</tr>
<tr>
<td>36% Milk</td>
<td>79% Milk</td>
</tr>
<tr>
<td>31% Coffee</td>
<td>36% Sugar, honey &amp; syrups</td>
</tr>
<tr>
<td>12% Eggs</td>
<td>26% Tea</td>
</tr>
</tbody>
</table>

BREAKFAST CEREAL TYPE

- 62% Less than 15g total sugars/100g
- 35% 15 to <30g total sugars/100g
- 3% 30g or more total sugars/100g
FIVE FOOD GROUPS

BC CONSUMERS ATE MORE DAILY GRAIN, FRUIT, DAIRY, AND LESS MEAT

<table>
<thead>
<tr>
<th>Food group</th>
<th>DAILY SERVES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SKIPPERS</td>
</tr>
<tr>
<td>Grain (cereal)</td>
<td>3.8\textsuperscript{a}</td>
</tr>
<tr>
<td>Fruit</td>
<td>1.1\textsuperscript{a}</td>
</tr>
<tr>
<td>Vegetables and legumes/beans</td>
<td>2.7\textsuperscript{a}</td>
</tr>
<tr>
<td>Lean meats and alternatives</td>
<td>2.3\textsuperscript{a,b}</td>
</tr>
<tr>
<td>Dairy and alternatives</td>
<td>1.1\textsuperscript{a}</td>
</tr>
</tbody>
</table>

Different superscript denotes significant difference between groups (p < 0.001)
Means, Adjusted for age, sex, their interaction, energy intake and BMI group.
### BC CONSUMERS ATE MORE FRUIT & DAIRY AT BREAKFAST AND REST OF DAY

<table>
<thead>
<tr>
<th>Food Group</th>
<th>Breakfast</th>
<th>Rest of Day</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NON CEREAL</td>
<td>BREAKFAST CEREAL</td>
</tr>
<tr>
<td>Grain (cereal)</td>
<td>1.4^a</td>
<td>2.1^b</td>
</tr>
<tr>
<td>Fruit</td>
<td>0.3^a</td>
<td>0.6^b</td>
</tr>
<tr>
<td>Vegetables and legumes/beans</td>
<td>0.2^a</td>
<td>0.0^b</td>
</tr>
<tr>
<td>Lean meats and alternatives</td>
<td>0.2^a</td>
<td>0.1^b</td>
</tr>
<tr>
<td>Dairy and alternatives</td>
<td>0.3^a</td>
<td>0.8^b</td>
</tr>
</tbody>
</table>

Means, Adjusted for age, sex, their interaction, energy intake and BMI group. Different superscript a,b denotes significant difference between groups (p < 0.001)

### BC CONSUMERS WERE MORE LIKELY TO MEET DAILY TARGETS OF ALL FOOD GROUPS EXCEPT LEAN MEATS

![Graph showing the percentage of consumers meeting daily targets for different food groups.](image)


P<0.001 for all food groups except lean meats (P=0.366)
DISCRETIONARY FOODS & BEVERAGES

BC CONSUMERS HAD THE LOWEST DISCRETIONARY SERVES

<table>
<thead>
<tr>
<th>Breakfast Cereal</th>
<th>Discretionary Serves</th>
</tr>
</thead>
<tbody>
<tr>
<td>SKIPPERS</td>
<td>6.3</td>
</tr>
<tr>
<td>NON-CEREAL</td>
<td>5.5</td>
</tr>
<tr>
<td>BREAKFAST CEREAL</td>
<td>4.5</td>
</tr>
</tbody>
</table>

Means, adjusted for age, sex, their interaction, energy intake and BMI group

Different superscript (a,b,c) denotes significant difference (p < 0.001)
BREAKFAST CEREAL CONSUMERS HAD 4 TIMES LESS DISCRETIONARY ENERGY AT BREAKFAST

<table>
<thead>
<tr>
<th>Discretionary Foods &amp; Beverages</th>
<th>NON CEREAL</th>
<th>BREAKFAST CEREAL</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breakfast DF (serves)</td>
<td>0.7</td>
<td>0.2</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Rest of day DF (serves)</td>
<td>5</td>
<td>4.6</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Proportion of breakfast energy that was DF (%)</td>
<td>23%</td>
<td>8%</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Adjusted for age, sex, their interaction, BMI group, and energy/energy at breakfast/energy at all other REO.

NUTRIENT INTAKES
### ENERGY & MACRONUTRIENTS

<table>
<thead>
<tr>
<th>Macronutrient</th>
<th>BREAKFAST</th>
<th></th>
<th>REST OF DAY</th>
<th></th>
<th>TOTAL DAY</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NON CEREAL</td>
<td>BREAKFAST CEREAL</td>
<td>NON-CEREAL</td>
<td>BREAKFAST CEREAL</td>
<td>BREAKFAST CEREAL</td>
<td></td>
</tr>
<tr>
<td>Energy (MJ)</td>
<td>1.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.8&lt;sup&gt;b&lt;/sup&gt;</td>
<td>7.1</td>
<td>7.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protein (g)</td>
<td>15.6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>14.1&lt;sup&gt;b&lt;/sup&gt;</td>
<td>76.2</td>
<td>78.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total fat (g)</td>
<td>13.7&lt;sup&gt;a&lt;/sup&gt;</td>
<td>8.1&lt;sup&gt;b&lt;/sup&gt;</td>
<td>64.8</td>
<td>65.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Saturated fat (g)</td>
<td>5.2&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.2&lt;sup&gt;b&lt;/sup&gt;</td>
<td>24.2</td>
<td>24.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbohydrate (g)</td>
<td>48.8&lt;sup&gt;a&lt;/sup&gt;</td>
<td>61.7&lt;sup&gt;b&lt;/sup&gt;</td>
<td>185.3</td>
<td>186.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Sugars (g)</td>
<td>20.8&lt;sup&gt;a&lt;/sup&gt;</td>
<td>28.7&lt;sup&gt;b&lt;/sup&gt;</td>
<td>84.8</td>
<td>86.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Added sugars (g)</td>
<td>8.6</td>
<td>8.3&lt;sup&gt;b&lt;/sup&gt;</td>
<td>44.1&lt;sup&gt;a&lt;/sup&gt;</td>
<td>39.9&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Free sugars (g)</td>
<td>11.3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>11.9&lt;sup&gt;b&lt;/sup&gt;</td>
<td>48.9&lt;sup&gt;a&lt;/sup&gt;</td>
<td>44.2&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fibre (g)</td>
<td>4.9&lt;sup&gt;a&lt;/sup&gt;</td>
<td>7.4&lt;sup&gt;b&lt;/sup&gt;</td>
<td>17.6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>19.5&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Means, adjusted for age, sex, their interaction, energy intake at breakfast and BMI group.

Different superscript a,b denotes significant difference between groups (p < 0.001)

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### % ENERGY FROM FREE SUGARS LOWEST AMONG BREAKFAST CEREAL CONSUMERS

- **12.7%** Breakfast sufferers
- **10.4%** Non-cereal breakfast consumers
- **9.8%** Breakfast cereal consumers

**ADDED SUGARS <1% OF TOTAL ENERGY**
### Micronutrients

<table>
<thead>
<tr>
<th>Micronutrient</th>
<th>Breakfast</th>
<th>Rest of Day</th>
<th>Total Day</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Non-Cereal</td>
<td>Breakfast Cereal</td>
<td>Non-Cereal</td>
</tr>
<tr>
<td>Niacin (mg)</td>
<td>8.4 a</td>
<td>9.1 b</td>
<td>32.8</td>
</tr>
<tr>
<td>Iron (mg)</td>
<td>2.3 a</td>
<td>5.0 b</td>
<td>8.2 a</td>
</tr>
<tr>
<td>Thiamin (mg)</td>
<td>0.5 a</td>
<td>0.8 b</td>
<td>1.0  b</td>
</tr>
<tr>
<td>Riboflavin (mg)</td>
<td>0.5 a</td>
<td>1.0 b</td>
<td>1.2 a</td>
</tr>
<tr>
<td>Folate (µg)</td>
<td>208 a</td>
<td>253 b</td>
<td>396 a</td>
</tr>
<tr>
<td>Calcium (mg)</td>
<td>177 a</td>
<td>291 b</td>
<td>580 a</td>
</tr>
<tr>
<td>Sodium (mg)</td>
<td>570 a</td>
<td>244 b</td>
<td>2069</td>
</tr>
<tr>
<td>Magnesium (mg)</td>
<td>69 a</td>
<td>98 b</td>
<td>264 a</td>
</tr>
<tr>
<td>Potassium (mg)</td>
<td>520 a</td>
<td>646 b</td>
<td>2405 a</td>
</tr>
</tbody>
</table>

Means, adjusted for age, sex, their interaction, energy intake at breakfast and BMI group. Different superscript a,b denotes significant difference between groups (p < 0.001).

### Percentage Contribution of Breakfast Cereal to Daily Nutrient Intakes: Breakfast Cereal Consumers*

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy</td>
<td>11%</td>
</tr>
<tr>
<td>Protein</td>
<td>8%</td>
</tr>
<tr>
<td>Total fat</td>
<td>6%</td>
</tr>
<tr>
<td>Saturated fat</td>
<td>4%</td>
</tr>
<tr>
<td>Carbohydrate</td>
<td>15%</td>
</tr>
<tr>
<td>Total sugars</td>
<td>8%</td>
</tr>
<tr>
<td>Added sugars</td>
<td>13%</td>
</tr>
<tr>
<td>Free sugars</td>
<td>12%</td>
</tr>
<tr>
<td>Fibre</td>
<td>22%</td>
</tr>
</tbody>
</table>

*Unadjusted
BC CONTRIBUTED 33% Fe, 36% B1

LIMITATIONS

1 day’s intake
Under-reporting
Cross-sectional
CONSISTENT WITH OTHER COUNTRIES

Consumption of Breakfast and the Type of Breakfast Consumed Are Positively Associated with Nutrient Intakes and Adequacy of Canadian Adults

Susan L. Barr, Loreta DiFrancesco, Victor L. Fulgoni, III


Abstract

Few studies have assessed the associations between breakfast intake and nutrient adequacy where inadequacy reflects prevalence of usual intakes below the estimated average requirement (EAR) and potential excess reflects the prevalence above the tolerable upper intake level (UL). This study examined associations among breakfast, nutrient intakes, and nutrient adequacy in Canadian adults. Respondents aged 65 years in the Canadian Community Health Survey 2.2 (n = 19,993) were classified as breakfast nonconsumers (19%), ready-to-eat cereal (RTEC) breakfast consumers (20%), or other breakfast consumers.

WHY ARE THEY HEALTHIER?

- Males & Older
- Higher SES
- More Physically Active
- Summer Waists
- Healthier Breakfast
- Less Discretionary Foods
- Greater Nutrients
- Healthier Diets
- More likely to meet targets

Lower BMI
THANK YOU

CO-AUTHORS
Andrew McConnell
Tim Cassettari
Prof Peter Petocz

RESEARCH GRANT

WWW.NRAUS.COM