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)

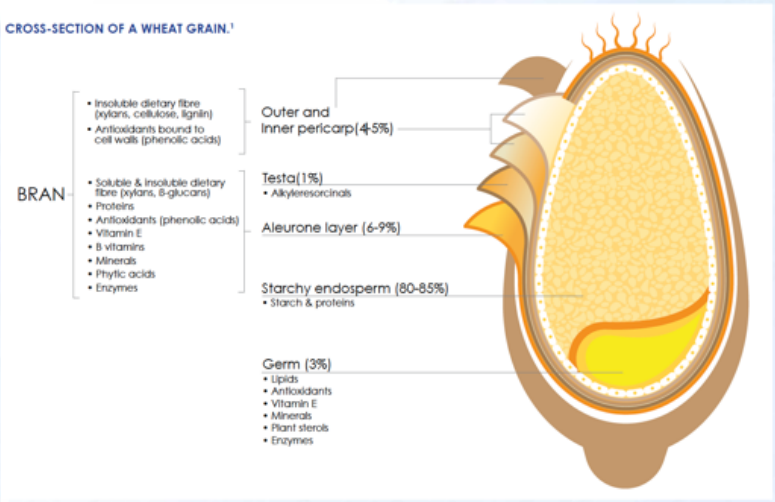
THE GUTS OF IT

Dr Joanna McMillan
APD & Nutrition Scientist

INTRODUCTION

- The gut microbiome is 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?

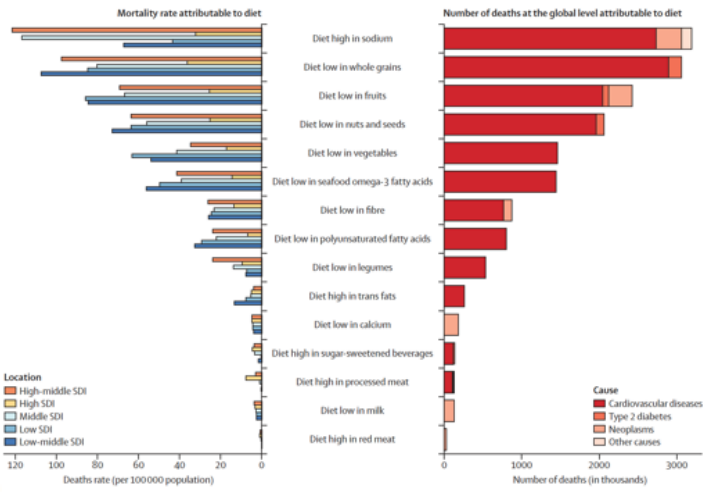
ANATOMY OF A GRAIN



DEFINITIONS

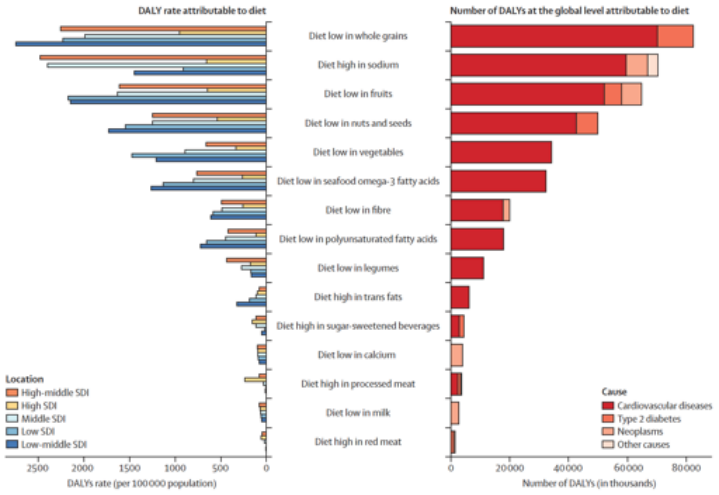
- Whole grain: The intact grain or the dehulled, ground, milled, cracked or flaked grain where the constituents – endosperm, germ and bran – are present in such proportions that represent the typical ratio of those fractions occurring in the whole cereal and includes wholemeal.
- Cereal fibre: These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

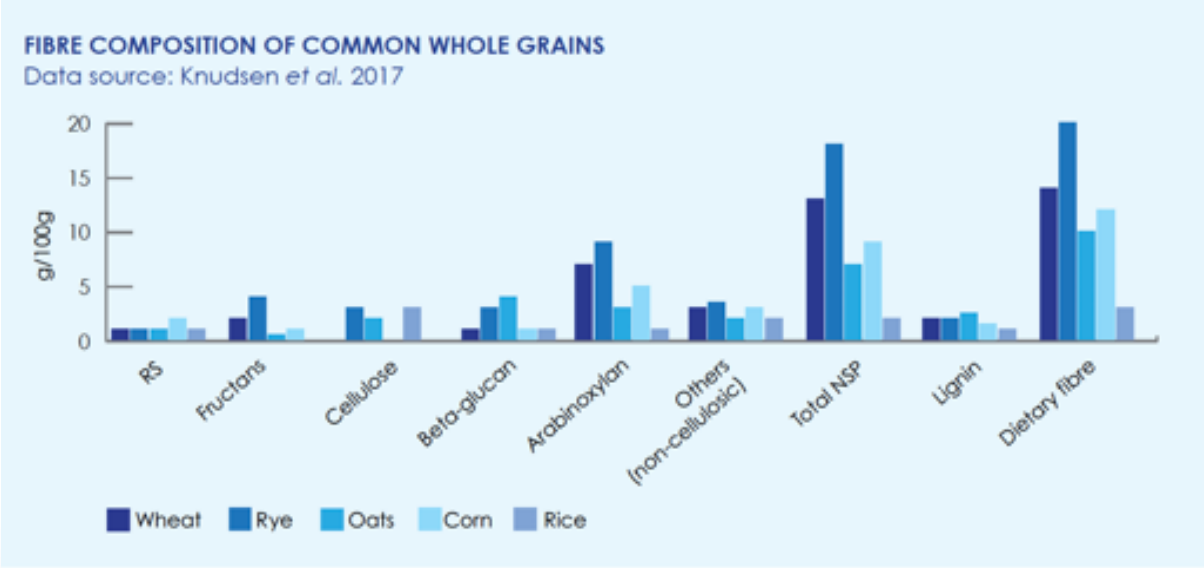
Lancet 2019;393:1958-72

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

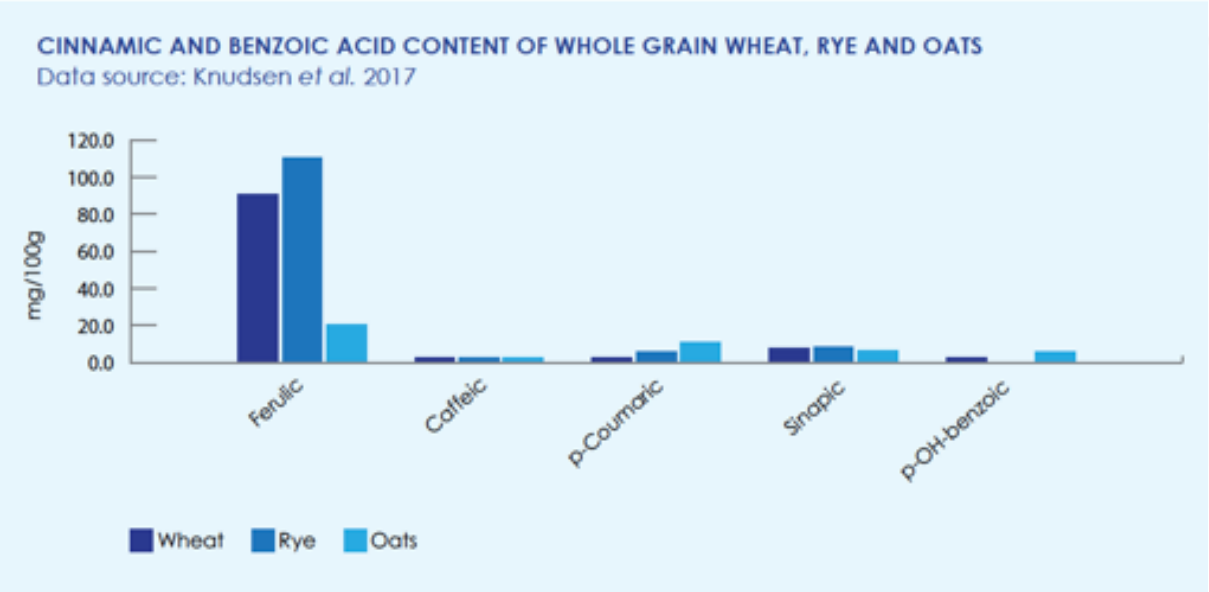
FIBRES PRESENT IN WHOLE GRAINS

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



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

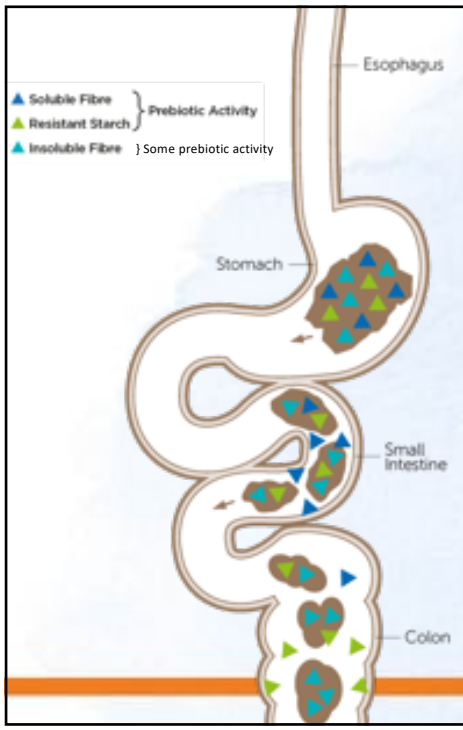
DIET IS RESPONSIBLE FOR AROUND 57% OF VARIATION – HUGE POTENTIAL THEREFORE FOR USING DIET TO INSTIGATE BENEFICIAL CHANGES

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

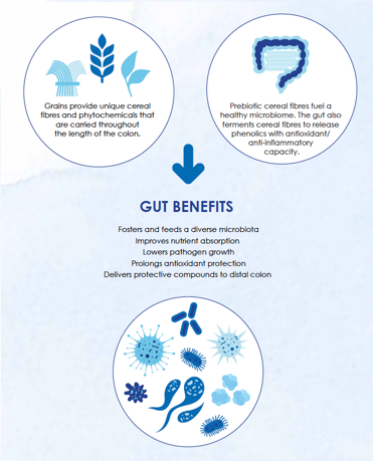
Some directly absorbed into bloodstream

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

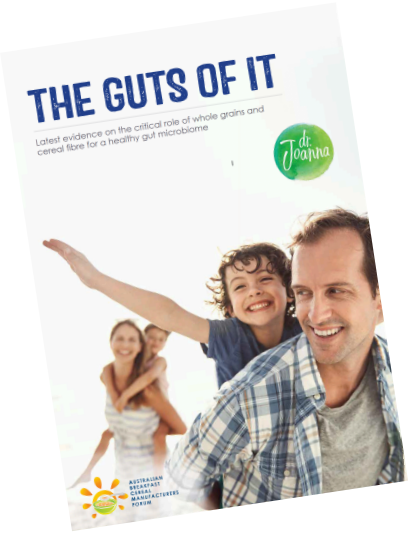
- Of the 88% of Australian adults who eat breakfast, almost half have breakfast cereal
- Those who do have healthier diets overall
- 40% of whole grains in Aus diets come from breakfast cereals
- Breakfast cereals & porridge provide 28.8% cereal fibre adults, 21.7% for children
- 70% of breakfast cereals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



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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

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23 September 2019

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NUTRITION RESEARCH

Open Access Article

Impact of Breakfast Skipping and Breakfast Choice on the Nutrient Intake and Body Mass Index of Australian Children

by Flavia Fayet-Moore [1,*], Jean Kim [2], Nilani Sritharan [3] and Peter Petocz [4]

[1] Nutrition Research Australia, Level 13 167 Macquarie Street, Sydney 2000, NSW, Australia
[2] Nestlé Australia, 1 Homebush Bay Drive, Rhodes 2138, NSW, Australia
[3] Cereal Partners Worldwide, Chemin du Viaduc 1, Prilly 1008, Vaud, Switzerland
[4] Department of Statistics, Macquarie University, Sydney 2109, NSW, Australia
[*] Author to whom correspondence should be addressed.

Nutrients **2016**, *8*(8), 487; https://doi.org/10.3390/nu8080487

Received: 14 June 2016 / Revised: 4 August 2016 / Accepted: 4 August 2016 / Published: 10 August 2016

Breakfast and Breakfast Cereal Choice and Its Impact on Nutrient and Sugar Intakes and Anthropometric Measures among a Nationally Representative Sample of Australian Children and Adolescents

by Flavia Fayet-Moore [1,*], Andrew McConnell [1], Kate Tuck [1] and Peter Petocz [2]

[1] Nutrition Research Australia, Level 13 167 Macquarie Street, Sydney 2000, Australia
[2] Department of Statistics, Macquarie University, Sydney 2109, Australia
[*] Author to whom correspondence should be addressed.

Nutrients **2017**, *9*(10), 1045; https://doi.org/10.3390/nu9101045

Received: 8 August 2017 / Revised: 9 September 2017 / Accepted: 13 September 2017 / Published: 21 September 2017

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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).

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METHODS

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

3 BREAKFAST GROUPS

SKIPPERS | **NON CEREAL** | **BREAKFAST CEREAL**

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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

SKIPPERS	NON CEREAL	BREAKFAST CEREAL
12%	47%	41%
More males	More females	More males
Youngest		Oldest
Lowest SES		Highest SES
More inactive		Less inactive

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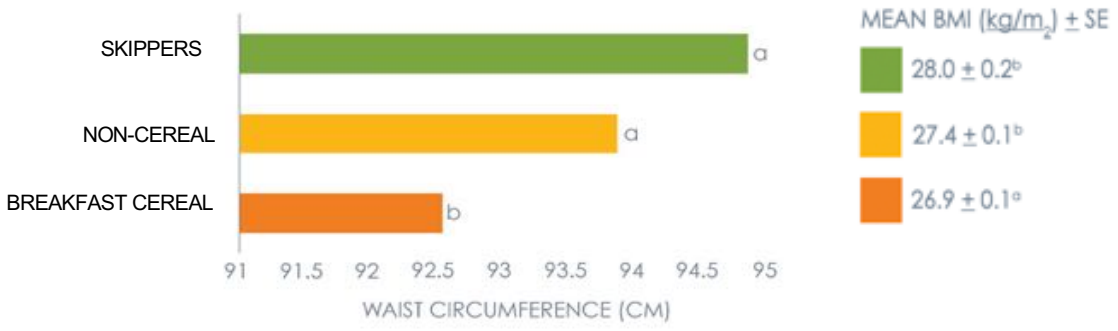
BREAKFAST CEREAL CONSUMERS HAD THE LOWEST BMI & WAIST CIRCUMFERENCE



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

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WHAT'S FOR BREAKFAST?

FOODS & CEREAL CONSUMED

% of consumers of food groups at breakfast

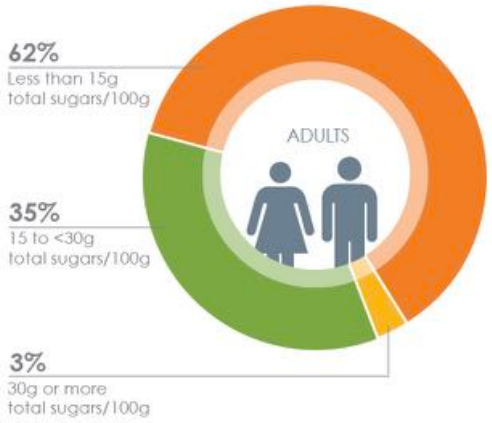
NON CEREAL

- **52%** Bread
- **36%** Milk
- **31%** Coffee
- **12%** Eggs

BREAKFAST CEREAL

- **82%** RTE cereal
- **79%** Milk
- **36%** Sugar, honey & syrups
- **26%** Tea

BREAKFAST CEREAL TYPE



FIVE FOOD GROUPS

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

Food group	DAILY SERVES		
	SKIPPERS	NON CEREAL	BREAKFAST CEREAL
Grain (cereal)	3.8 [a]	4.4 [b]	↑ 5.2 [c]
Fruit	1.1 [a]	1.4 [b]	↑ 1.8 [c]
Vegetables and legumes/beans	2.7 [a]	3.1 [b]	— 3.2 [b]
Lean meats and alternatives	2.3 [a,b]	2.2 [a]	↓ 2.0 [b]
Dairy and alternatives	1.1 [a]	1.2 [a]	↑ 1.8 [b]

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

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BC CONSUMERS ATE MORE FRUIT & DAIRY AT *BREAKFAST* AND *REST OF DAY*

Food Food group	BREAKFAST		REST OF DAY	
	NON CEREAL	BREAKFAST CEREAL	NON CEREAL	BREAKFAST CEREAL
Grain (cereal)	1.4 [a]	2.1 [b] ↑	3.1 [b]	3.1 [b] —
Fruit	0.3 [a]	0.6 [b] ↑	1.1 [a]	1.3 [b] ↑
Vegetables and legumes/beans	0.2 [a]	0.0 [b] ↓	2.8 [a]	3.2 [b] ↑
Lean meats and alternatives	0.2 [a]	0.1 [b] ↓	2.0 [b]	2.0 [b] —
Dairy and alternatives	0.3 [a]	0.8 [b] ↑	0.9 [b]	1.0 [a] ↑

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

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

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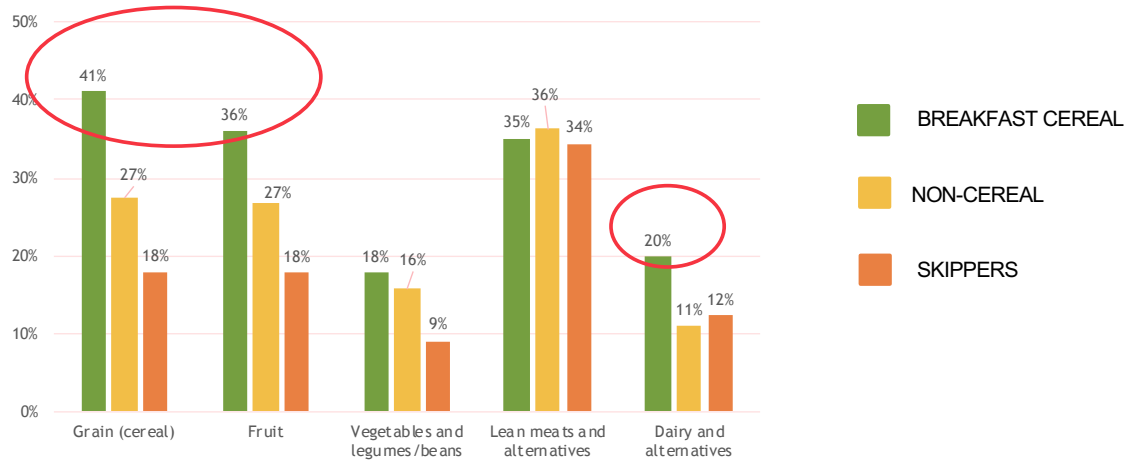
BC CONSUMERS WERE MORE LIKELY TO MEET DAILY TARGETS OF ALL FOOD GROUPS EXCEPT LEAN MEATS



P<0.001 for all food groups except lean meats (*P*=0.366)

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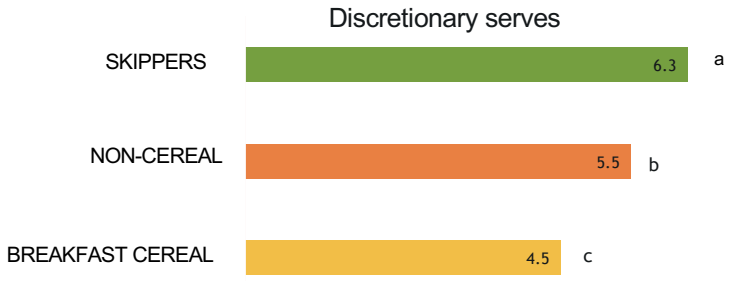
DISCRETIONARY FOODS & BEVERAGES

BC CONSUMERS HAD THE LOWEST DISCRETIONARY SERVES



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

Different superscript (a,b,c) denotes significant difference ($p < 0.001$)

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BREAKFAST CEREAL CONSUMERS HAD 4 TIMES LESS DISCRETIONARY ENERGY AT BREAKFAST

Discretionary Foods & Beverages	NON CEREAL	BREAKFAST CEREAL	*P* value
Breakfast DF (serves)	0.7	0.2 ↓	<0.001
Rest of day DF (serves)	5	4.6 ↓	<0.001
Proportion of breakfast energy that was DF (%)	23%	8% ↓	<0.001

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

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NUTRIENT INTAKES

ENERGY & MACRONUTRIENTS

Macronutrient	BREAKFAST			REST OF DAY			TOTAL DAY
	NON CEREAL	BREAKFAST CEREAL		NON-CEREAL	BREAKFAST CEREAL		BREAKFAST CEREAL
Energy (MJ)	1.5 [a]	1.8 [b]	↑	7.1	7.0		↑
Protein (g)	15.6 [a]	14.1 [b]	↓	76.2	78.8		–
Total fat (g)	13.7 [a]	8.1 [b]	↓	64.8	65.1		↓
Saturated fat (g)	5.2 [a]	3.2 [b]	↓	24.2	24.4		↓
Carbohydrate (g)	48.8 [a]	61.7 [b]	↑	185.3	186.7		↑
Total Sugars (g)	20.8 [a]	28.7 [b]	↑	84.8	86.4		↑
Added sugars (g)	8.6	8.3	–	44.1[a]	39.9 [b]	↓	↓
Free sugars (g)	11.3	11.9	–	48.9 [a]	44.2 [b]	↓	↓
Fibre (g)	4.9 [a]	7.4 [b]	↑	17.6 [a]	19.5 [b]	↑	↑

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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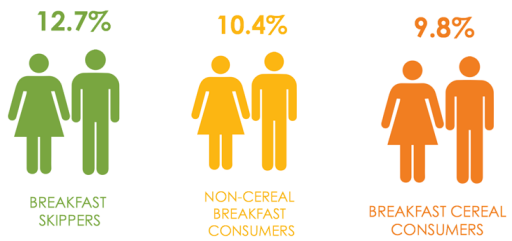
% ENERGY FROM FREE SUGARS LOWEST AMONG BREAKFAST CEREAL CONSUMERS



MICRONUTRIENTS

Micronutrient	BREAKFAST		REST OF DAY		TOTAL DAY
	NON CEREAL	BREAKFAST CEREAL	NON-CEREAL	BREAKFAST CEREAL	BREAKFAST CEREAL
Niacin (eqv) (mg)	8.4 [a]	9.1 [b] ↑	32.8	33.8	↑
Iron (mg)	2.3 [a]	5.0 [b] ↑	8.2 [a]	8.7 [b] ↑	↑
Thiamin (mg)	0.5 [a]	0.8 [b] ↑	1.0	1.1	↑
Riboflavin (eqv) (mg)	0.5 [a]	1.0 [b] ↑	1.2 [a]	1.4 [b] ↑	↑
Folate (µg)	208 [a]	253 [b] ↑	396 [a]	449 [b] ↑	↑
Calcium (mg)	177 [a]	291 [b] ↑	580 [a]	644 [b] ↑	↑
Sodium (mg)	570 [a]	244 [b] ↓	2069	2075	↓
Magnesium (mg)	69 [a]	98 [b] ↑	264 [a]	276 [b] ↑	↑
Potassium (mg)	520 [a]	646 [b] ↑	2405 [a]	2539 [b] ↑	↑

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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PERCENTAGE CONTRIBUTION OF BREAKFAST CEREAL TO DAILY NUTRIENT INTAKES: BREAKFAST CEREAL CONSUMERS*

Energy	11%
Protein	8%
Total fat	6%
Saturated fat	4%
Carbohydrate	15%
Total sugars	8%
Added sugars	13%
Free sugars	12%
Fibre	22%

*Unadjusted

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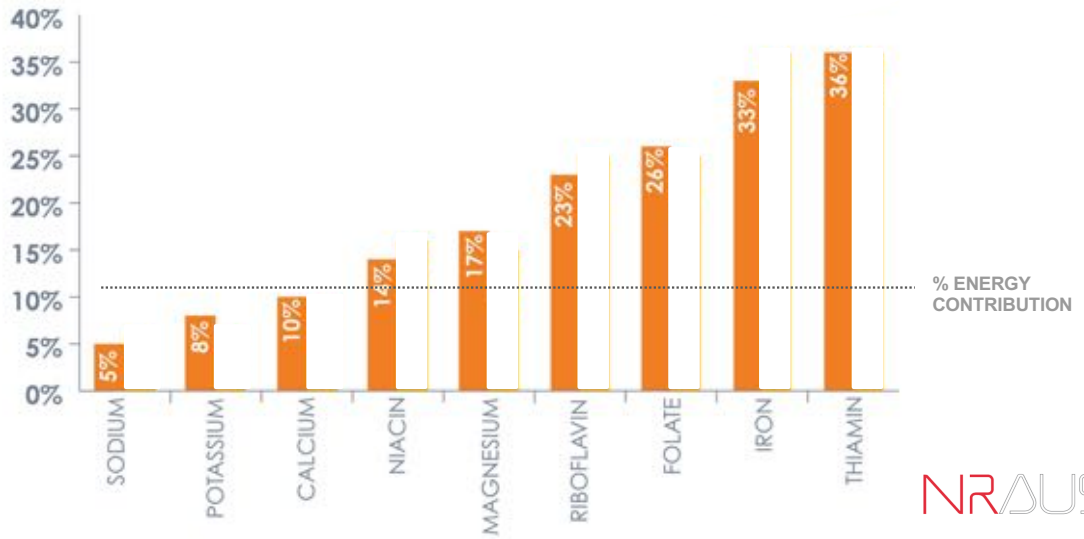
BC CONTRIBUTED 33% Fe, 36% B1



Unadjusted

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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 FREE

Susan I. Barr, Loretta DiFrancesco, Victor L. Fulgoni, III

The Journal of Nutrition, Volume 143, Issue 1, January 2013, Pages 86–92,
https://doi.org/10.3945/jn.112.167098
Published: 21 January 2013 **Article history** ▾

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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 ≥19 y in the Canadian Community Health Survey 2.2 (n = 19,913) were classified as breakfast nonconsumers (11%), ready-to-eat cereal (RTEC) breakfast consumers (20%), or other breakfast consumers

The effect of breakfast type on total daily energy intake and body mass index: results from the Third National Health and Nutrition Examination Survey (NHANES III).

Sungsoo Cho, M. Dietrich, Coralie J P Brown, Celeste A Clark, Gladys Block less •

Published in Journal of the American College of Nutrition 2003 • DOI: 10.1080/07315724.2003.10719307

OBJECTIVE
The objective of this study was to investigate the relationship between breakfast type, energy intake and body mass index (BMI). We hypothesized not only that breakfast consumption itself is associated with BMI, but that the type of food eaten at breakfast also affects BMI.

ORIGINAL RESEARCH

Do Breakfast Skipping and Breakfast Type Affect Energy Intake, Nutrient Intake, Nutrient Adequacy, and Diet Quality in Young Adults? NHANES 1999–2002

Priya R Deshmukh-Taskar, MSc, MS, John D Radcliffe, PhD, RD, Yan Liu, MS & Theresa A Nicklas, DrPH

Pages 407-418 | Received 09 Jul 2009, Accepted 09 Jun 2010, Published online: 09 Jun 2013
Download citation https://doi.org/10.1080/07315724.2010.10719858

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Abstract

Objective: To assess the impact of breakfast skipping and type of breakfast consumed on energy/nutrient intake, nutrient adequacy, and diet quality.

Design: Cross-sectional.

Setting: The National Health and Nutrition Examination Survey (NHANES), 1999–2002.

Subjects: Young adults (20–39 years, n = 2615).

Measures: A 24-hour dietary recall was used, with breakfast defined as self-reported. Covariate-adjusted sample-weighted means for the entire day's energy/nutrient intakes, mean adequacy ratio (MAR) for

WHY ARE THEY HEALTHIER?

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THANK YOU

CO-AUTHORS
Andrew McConnell
Tim Cassettari
Prof Peter Petocz

RESEARCH GRANT

AUSTRALIAN BREAKFAST CEREAL MANUFACTURERS FORUM

Love cereal4brekkie

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