Whole Grain & Diabetes: Reducing the Risk and Implications to Healthcare

November 14, 2022

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OLDWAYS

About Oldways

- **Our Vision**
  A healthier, happier life through cultural food traditions.
- **Our Mission**
  We inspire people to embrace the healthy, sustainable joys of the old ways of eating.
- **Best Known for**
  Creating the Mediterranean Diet Pyramid and other Heritage Diet Pyramids, Creating the Whole Grain Stamp, Culinary Travel

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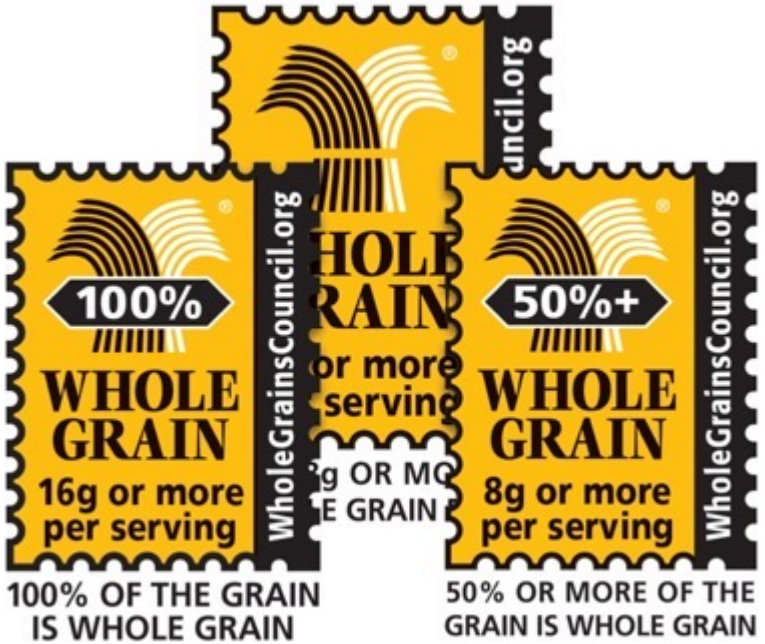
About the Oldways Whole Grains Council

Our three-part mission:

- To help consumers find whole grain foods and understand their health benefits
- To help manufacturers and restaurants create delicious whole grain foods
- To help the media write accurate and compelling stories about whole grains



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Housekeeping

- Attendees will receive an email within ONE WEEK with **CPEU certificate**, **slides**, and **recording**
- Visit **oldwayspt.org/CPEU** to register for upcoming webinars or view recordings of previous webinars
- Please submit any questions using the Q&A function in Zoom
- Thank you to the General Mills Bell Institute of Health and Nutrition!

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Today's Speakers

Dr. Kevin Miller
Principal Scientist
Bell Institute of Health and Nutrition
General Mills

Dr. Sara Grafenauer
Discipline Lead
Dietetics and Food Innovation Program
University of New South Wales

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Whole grain and diabetes

Kevin B Miller, PhD

Principal Scientist

Bell Institute of Health & Nutrition

Outline

- Diabetes in America
- DGA recommendations for grains
- Grains, fiber, and diabetes risk
- Whole grain foods, processing, and diabetes
- Sorting out confusing science
- Conclusion

Diabetes in America

Estimated 130 Million with diabetes in America (population 331 Million)

Between 117 and 123 Million (90-95%) are Type-2

CDC 2022 National Diabetes Statistics Report

Minorities have highest percentage of adults with diagnosed diabetes

Adults with a family income below poverty level had the highest prevalence (13.7% men, 14.4% women)

Lower education level more likely to have diagnosed diabetes

We consume Whole Grain as a food group, not a nutrient

Dietary Guidelines for Americans recommends fruits, vegetables, and whole grains.

Recommendation assumes variety of food group intake for broad benefits

Whole grain foods and diabetes (T2) risk

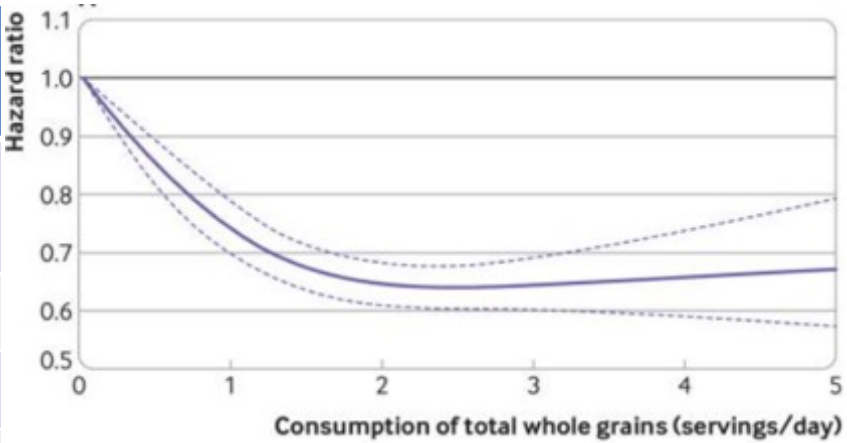
Associations between the intake of total and individual whole grain foods and T2DM risk

Prospective cohort studies: Average follow-up time - 24 years

158,259 women and 36,525 men who *did not have* type 2 diabetes, cardiovascular disease, or cancer at baseline.

Nurses' Health Study (1984-2014)
Nurses' Health Study II (1991-2017)
Health Professionals Follow-Up Study (1986-2016)

	0-<1 serv /month	1 serv / month – 1 serv / wk	1 serv / wk – 6 serv / wk	≥1 serv / day
WG RTE Cereal	1.0	0.92	**0.67**	**0.66**
Dark bread	1.0	0.94	**0.77**	**0.78**
Popcorn	1.0	1.06	1.09	1.46
Oatmeal	1.0	0.94	**0.69**	---
Brown rice	1.0	0.93	**0.79**	---



thebmj

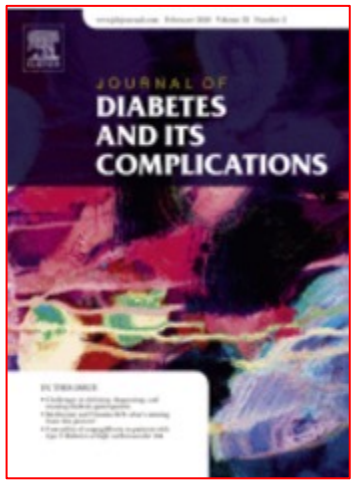
https://pubmed.ncbi.nlm.nih.gov/32641435

Whole grain benefits often attributed to fiber, but wait…there's more

Dietary fiber's benefits include improving gut function, promote satiety, improve diet (e.g., reduce fat, lower energy intake), and glucose metabolism

Different fiber : different benefit

Insoluble, non-viscous, cereal fiber	vs.	Soluble, viscous, fruit fiber



Davison et al. 2018.
Cereal fiber, fruit fiber, and type 2 diabetes: Explaining the paradox

In amounts typical consumed, cereal fiber more protective against T2DM

Cereal fiber helps:

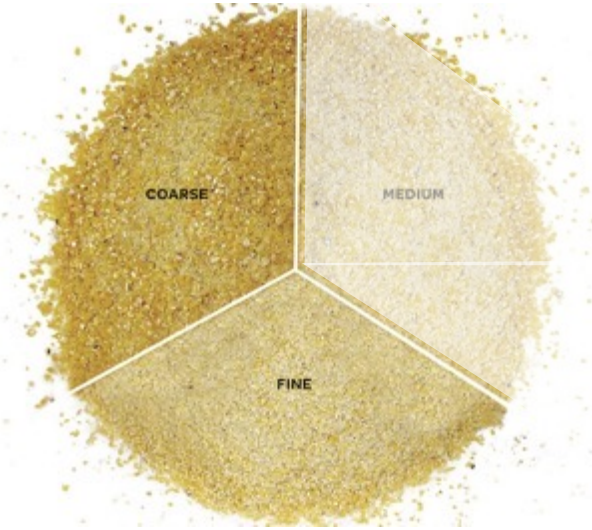
1) modulate gut microbiota
2) improving glucose tolerance via energy metabolism pathways (e.g., colonic fermentation to SCFA)
3) reduce inflammation
4) improve immune response via microbiome

More knowledge needed on specific host and gut microbial functional pathways involved in T2DM development and the potential role of cereal fiber

Processing grains impacts food's glycemic response

Less-processed WG	**Finely milled WG**
Traditional oats (cooked) Brown rice (cooked) Coarsely milled bread	Instant oats (cooked) Brown rice pasta (cooked) Finely milled bread

	RCT Interventions	
Meals iAUC (mmol / L / min)	423 +/- 210	466* +/- 192
Hours in range (3.9 -10 mmol/L)	15.49 +/- 6.77	15.18 +/- 6.74
Hours above range (>10 mmol/L)	7.9 +/- 7.0	8.2 +/- 7.1
Mean ampl. of glycemic excursion (MAGE)	5.6 +/- 2.7	5.9* +/- 2.6
Body Weight	-0.5* kg	+0.4* kg



Author conclusion:
Less-processed wholegrain foods improved postprandial glycemia and other indices of glycemic control in adults with T2DM

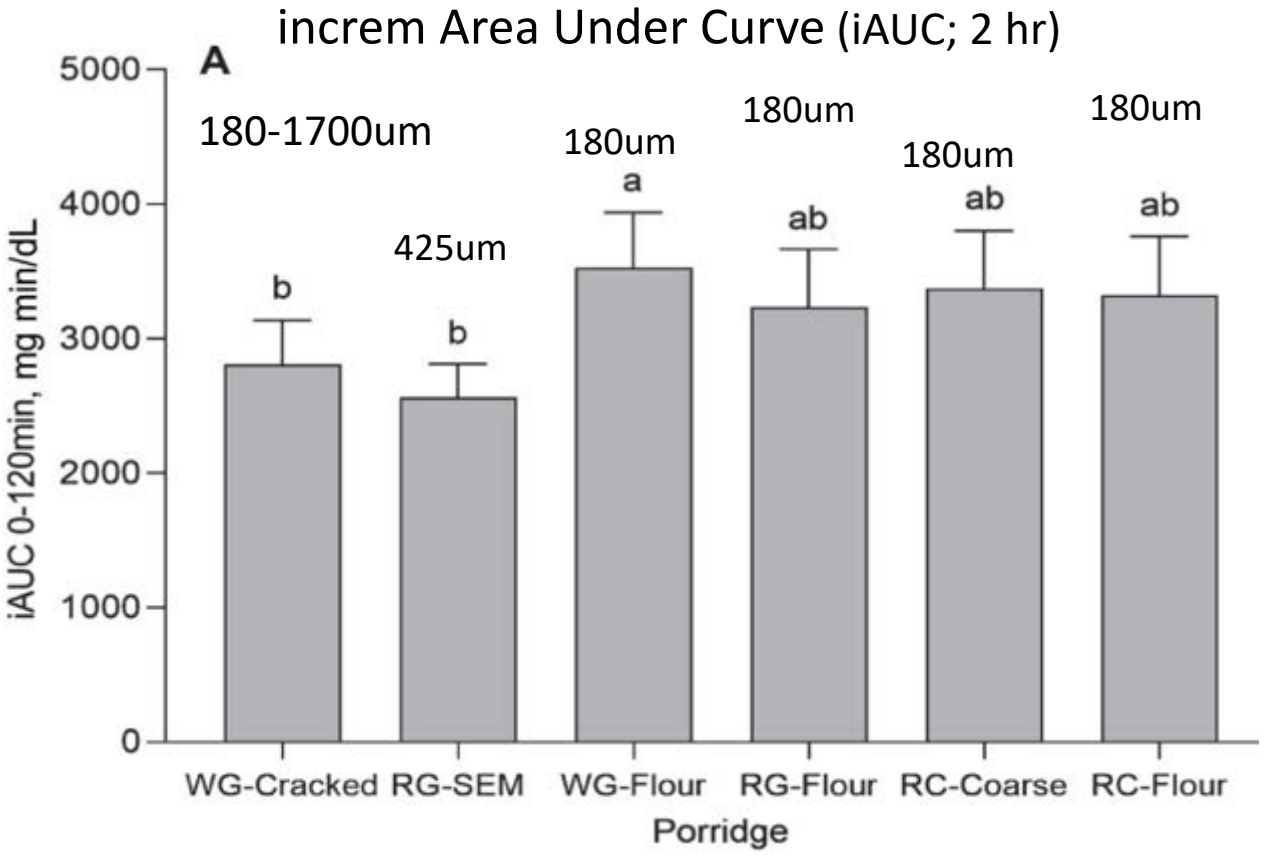
American Diabetes Association. Diabetes Care

Aberg et al. 2020. Whole-Grain Processing and Glycemic Control in Type 2 Diabetes: A Randomized Crossover Trial

Glycemic response not different between whole versus refined grain

Postprandial GRs were not different between whole grain and refined wheat milled products. Particle size may be important on glycemia

Wheat fractions		Particle size
Cracked wheat (WG-Cracked)		180 – 1700 µm
Semolina (RG-SEM)		425 µm
Whole grain wheat flour (WG-Flour)		180 µm
Refined wheat flour (RG-Flour)		180 µm
Reconstituted coarse (RC-Coarse); bran shown in photo		1700 µm (bran) and 180 µm (flour)
Reconstituted fine (RC-Flour); bran shown in photo		180 µm (bran and flour)



The American Journal of CLINICAL NUTRITION

https://pubmed.ncbi.nlm.nih.gov/34999739/

WHO draft guidelines on carbohydrates

Recommendation #1:

"WHO recommends that carbohydrate intake should come primarily from whole grains, vegetables, fruits and pulses (strong recommendation)"

Whole Grains

"Because there is evidence to suggest that the naturally occurring structure of intact whole grains contributes to its observed health effects, minimally processed whole grains are preferred"

Additional Dietary Considerations [and confusing remark given processing was criticized]

"Plant-based foods contain a variety of compounds, some of which are shown to inhibit absorption of certain nutrients (many of which have also been shown to have a health benefit…)" Preparation methods including heating, soaking, germinating, fermentation reduce the inhibitory potential.

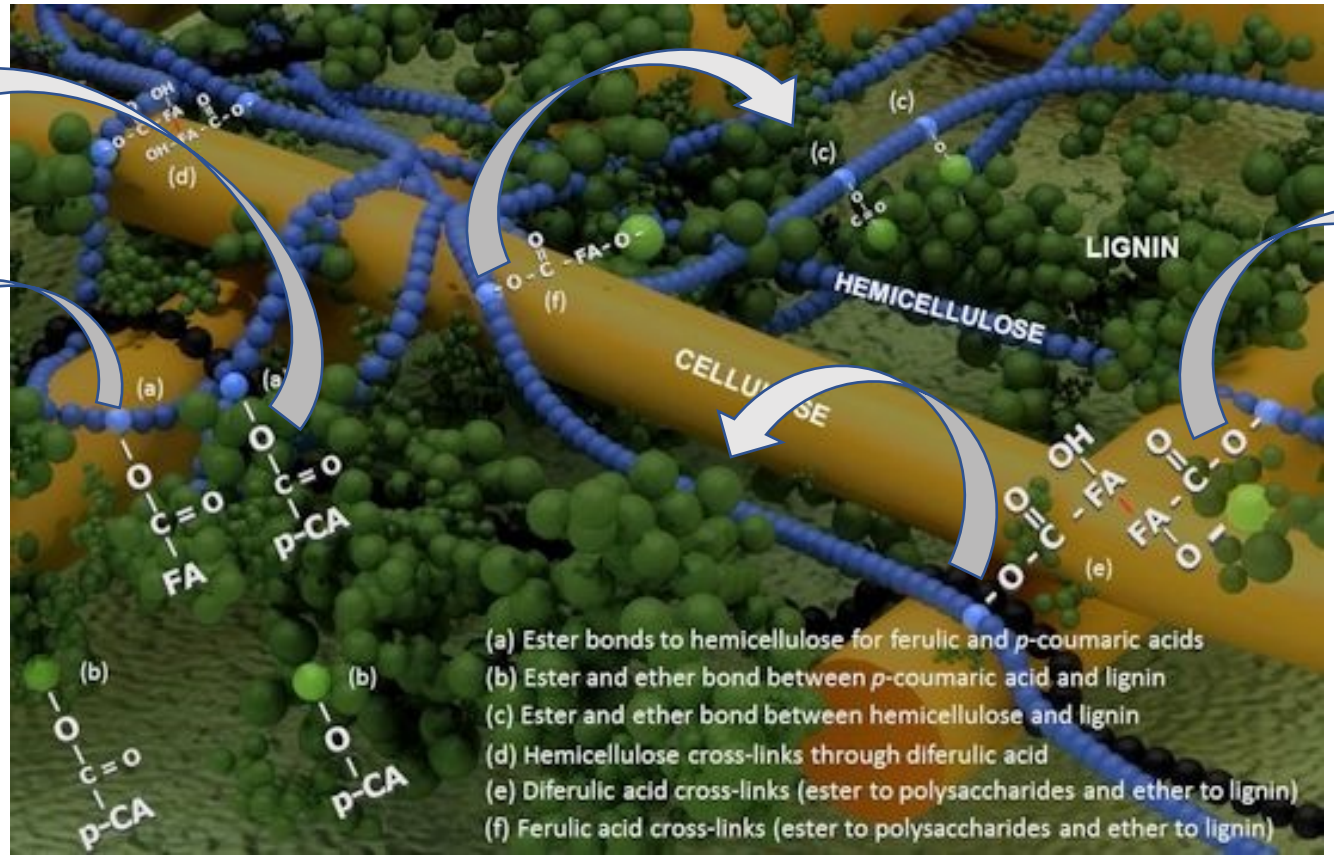
Processing helps liberate antioxidants from grain matrix

Phytonutrient / bioactives bound to fibers in grain (bran). Processing disrupts the matrix (cellulose, hemicellulose, and lignin); phenolic antioxidant compounds are bioavailable

Coumaric acid

Ferulic acid

Li et al. 2016
Phenolic recovery and bioaccessibility from milled and finished whole grain oat products



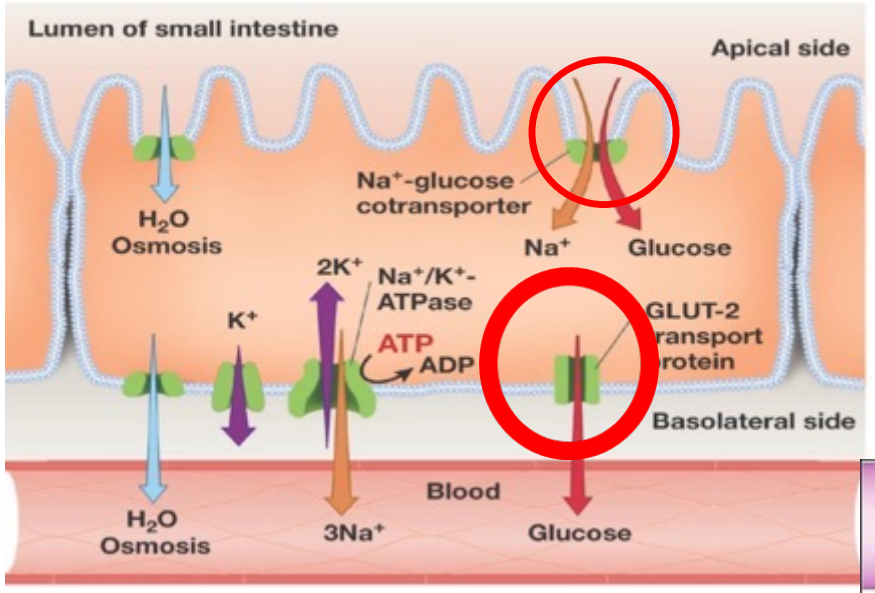
Ferulic acid

- Hemicellulose
- Lignin

p-FA: Ferulic acid

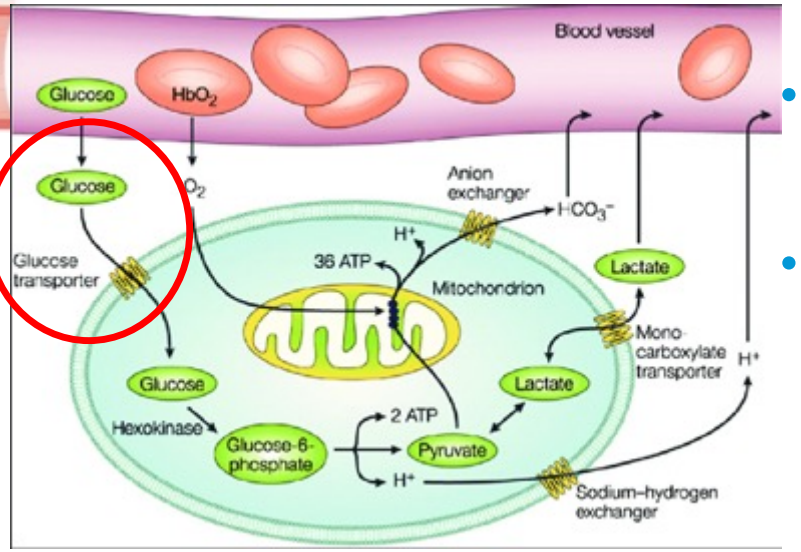
p-CA: Coumaric acid

Mechanism of whole grain reducing glycemic response

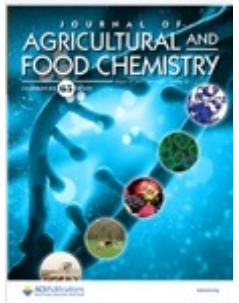


Mechanisms explaining how whole grain fiber and phenolics (ferulic acid, coumaric acid, avenanthramides) reduce glycemia and reduce risk of diabetes

- Fiber slows absorption of glucose from gut & increase SCFA via fermentation
- Phenolics inhibit glucose transport



- Phenolics help insulin sensitivity for glucose clearance
- Antioxidant phenolics reduce inflammation



Li et al. 2017
Phenolics from Whole Grain Oat Products as Modifiers of Starch Digestion and Intestinal Glucose Transport

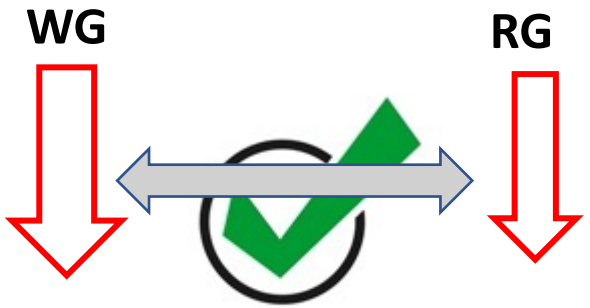
Why the conflicting evidence on whole grain foods?

- **Science both shows whole grains reduce risk of disease(s), but other studies show no difference in glycemic response implying higher risk for diabetes.**
- **Conclusions depending on type of research conducted**

Randomized Controlled Trials

Typically examines specific effect of one modifiable variable (e.g., food, nutrient)

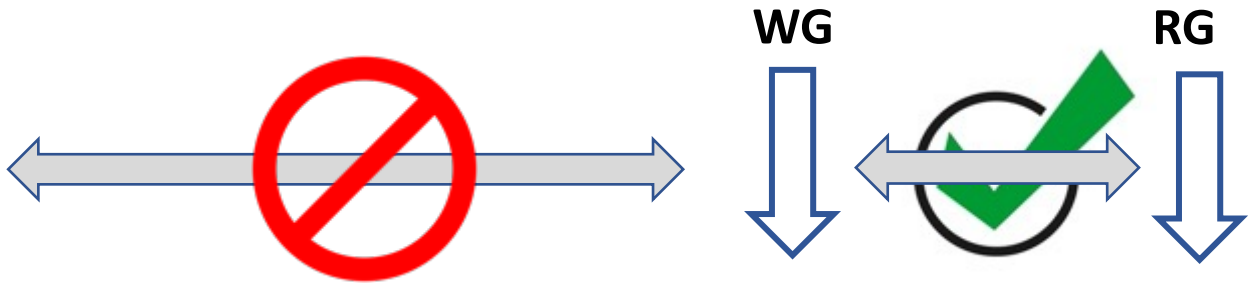
Assigned Whole Grain or Refined Grain



Prospective Cohort Trials

Often examine the interaction of foods within the diet as consumed

Chooses Whole Grain or Refined Grain



Conclusion

- Research demonstrates populations consuming more whole grain are less likely to have or develop diabetes (T2DM), heart disease, and certain cancers
- Whole grains contribute nutrients that modify glycemic response: cereal fiber, protein, micro- and *phytonutrients*
- Scientific conclusions about whole grain and diabetes may appear contradictory, but development and management of diabetes are not functions of glycemic index
- Milling whole grains increases bioavailability of starch (glucose). For diabetics, consider the serving size of the food (glycemic load) in making recommendations

WG & Diabetes

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UNSW Medicine & Health

National Diabetes awareness month

Health care cost savings associated with optimal whole grain intake in Diabetes

A/Prof Sara Grafenauer, Discipline Lead

Nutrition, Dietetics & Food Innovation

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Acknowledging my co-authors and GLNC

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Whole Grain Anatomy

Why Nutrition Economics?

The key elements in the calculations: risk reduction & discounted rate

Communicating the economic benefit

Prioritising whole grain & simple swaps

Whole grains in policy

Diabetes

- One in 20 people in Australia has Diabetes
- 1.3 million people (5.3%) with 1 in 5 over 75 years of age.
- Most (85%) of these have Type 2 Diabetes
- In 2020, Diabetes was the 7th leading cause of death
- **More than 37 million Americans have diabetes (about 1 in 10), approximately 90-95% of them have Type 2 Diabetes**

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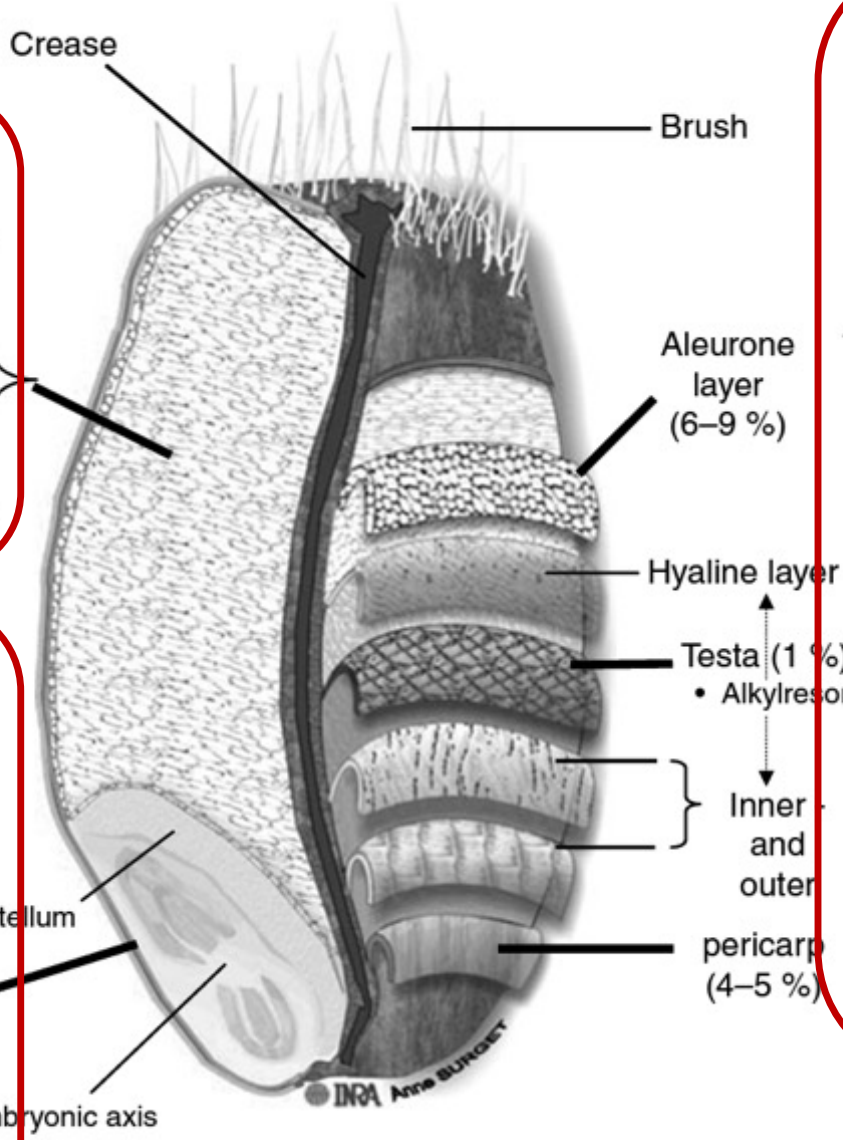
Starchy endosperm (80–85 %)

- Starch and proteins (sulfur amino-acids)
- β-Glucans, arabinoxylans
- Carotenoids
- Se
- Thiamin (B_1) and vitamin E
- Flavonoids (anthocyanins)

Germ (3 %)

- Lipids (α-linolenic acid)
- Sucrose and monosaccharides
- Sulfur amino acids
- Glutathione
- Insoluble and soluble fibre, raffinose
- Flavonoids
- Vitamin E
- B vitamins
- Minerals and trace elements
- Phytosterols
- Betaine and choline
- Policosanol
- Enzymes
- *Myo*-inositol



Bran*

- Soluble and insoluble dietary fibre (xylans, β-glucans, raffinose, stachyose, fructans)
- Proteins (sulfur amino acids and glutathione)
- Antioxidants (phenolic acids, carotenoids, lignans, anthocyanins, isoflavonoids)
- Vitamin E
- B vitamins
- Minerals and trace elements
- Phytic acid
- Betaine and choline
- Enzymes

- Insoluble dietary fibre (xylans, cellulose, lignin)
- Antioxidants bound to cell walls (phenolic acids)

- Policosanol
- Phytosterols

Nutrient bundle…

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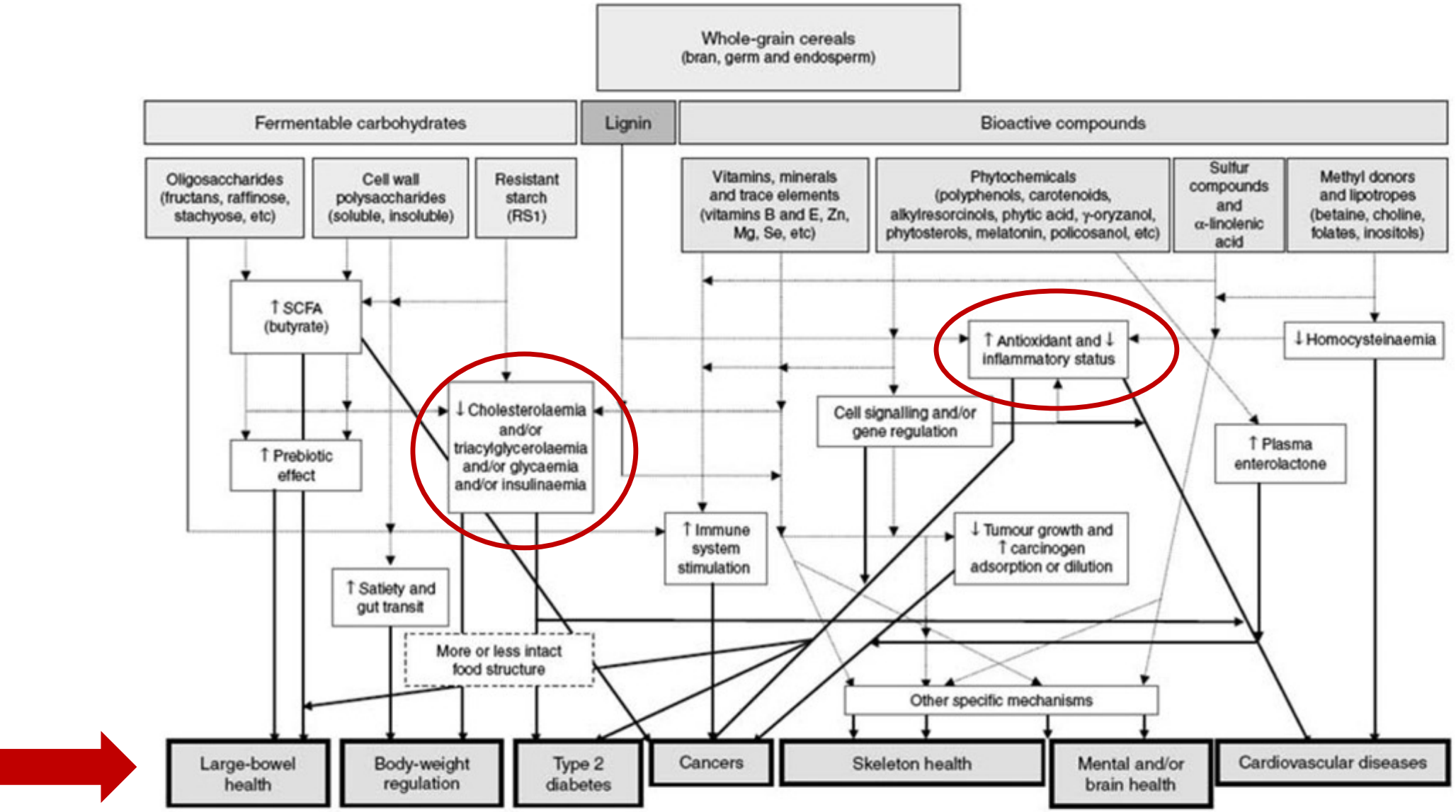

Fig 2. Current and new proposed physiological mechanisms involved in protection by whole grain cereals. The dotted thin arrows indicate the link between whole grain bioactive compounds and protective physiological mechanisms, while the colored plain arrows indicate the relationship between physiological mechanisms and health outcomes.

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Why Nutrition Economics?

- Leverages existing research – % risk reduction
- Treatment costs for communicable disease treatment are increasing
- Acknowledges a human cost – lost productivity
- Politically astute – helps to establish evidence for nutrition that has meaning
- Provides a performance indicator for a snap-shot in time whereby we can assess other nutrition initiatives…

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Nutrition economics whole grain publications


Open Access Article

Healthcare Cost Savings Associated with Increased Whole Grain Consumption among Australian Adults

by Mohammad M. H. Abdullah [1,*], Jaimee Hughes [2] and Sara Grafenauer [2,3]

1. CVD & Type 2 Diabetes (AUS)


nutrients

MDPI

Article

Whole Grain Intakes are Associated with Healthcare Cost Savings Following Reductions in Risk of Colorectal Cancer and Total Cancer Mortality in Australia: A Cost-of-Illness Model

Mohammad M.H. Abdullah [1*], Jaimee Hughes [2] and Sara Grafenauer [2,3]

2. Total Cancer & Colorectal Cancer (AUS)


nutrients

MDPI


Article

Type 2 Diabetes-Related Health Economic Impact Associated with Increased Whole Grains Consumption among Adults in Finland

Janne Martikainen [1,*], Kari Jalkanen [1], Jari Heiskanen [1], Piia Lavikainen [1], Markku Peltonen [2], Tiina Laatikainen [2,3,4] and Jaana Lindström [2]

3. Type 2 Diabetes (FIN)


nutrients

MDPI


Communication

Cardiovascular Healthcare Cost Savings Associated with Increased Whole Grains Consumption among Adults in the United States

Mary M. Murphy [1,*,†] and Jordana K. Schmier [2,†]

4. CVD (US)


Journal of Cereal Science 105 (2022) 103455

Contents lists available at ScienceDirect

Journal of Cereal Science

journal homepage: www.elsevier.com/locate/jcs

Nutrition economics: Four analyses supporting the case for whole grain consumption

Kevin B. Miller [a,*], Sara J. Grafenauer [b,c], Janne Martikainen [d]

5. Three country analysis

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Methodology

Calculations involve a number of publicly available sources:

1. CONSUMPTION DATA

National Nutrition Survey Data 2011-12 – A secondary analysis of whole grain intake (Galea et al).

Calculation was based on the assumption that adults >20years are consuming 21g /day indicating a 27g

gap in whole grain consumption

2. COST DATA

Australian Institute of Health & Welfare – health care costs & productivity losses for Type 2 Diabetes

Mellitus and Cardiovascular Disease

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Risk Reduction Data

3. ESTABLISHED RISK REDUCTION DATA

Risk Reduction percentage relating to the disease when 48g daily target intake is consumed (90g of food)

32% reduction for Type 2 Diabetes[1]

& 13% reduction for Cardiovascular Disease[2]

1. Aune, D, et al. Whole grain and refined grain consumption and the risk of type 2 diabetes: A systematic review and dose–response meta-analysis of cohort studies. *Eur. J. Epidemiology* **2013**, *28*, 845–858.
2. Aune, D, et al. Whole grain consumption and risk of cardiovascular disease, cancer, and all cause and cause specific mortality: Systematic review and dose-response meta-analysis of prospective studies. *BMJ* **2016**, *353*, i2716
NOTE Hu et al 2020 - T2DM RR@ 1 serve WG -27% (HR) 0.73) RR@ 2 serves WG-35%

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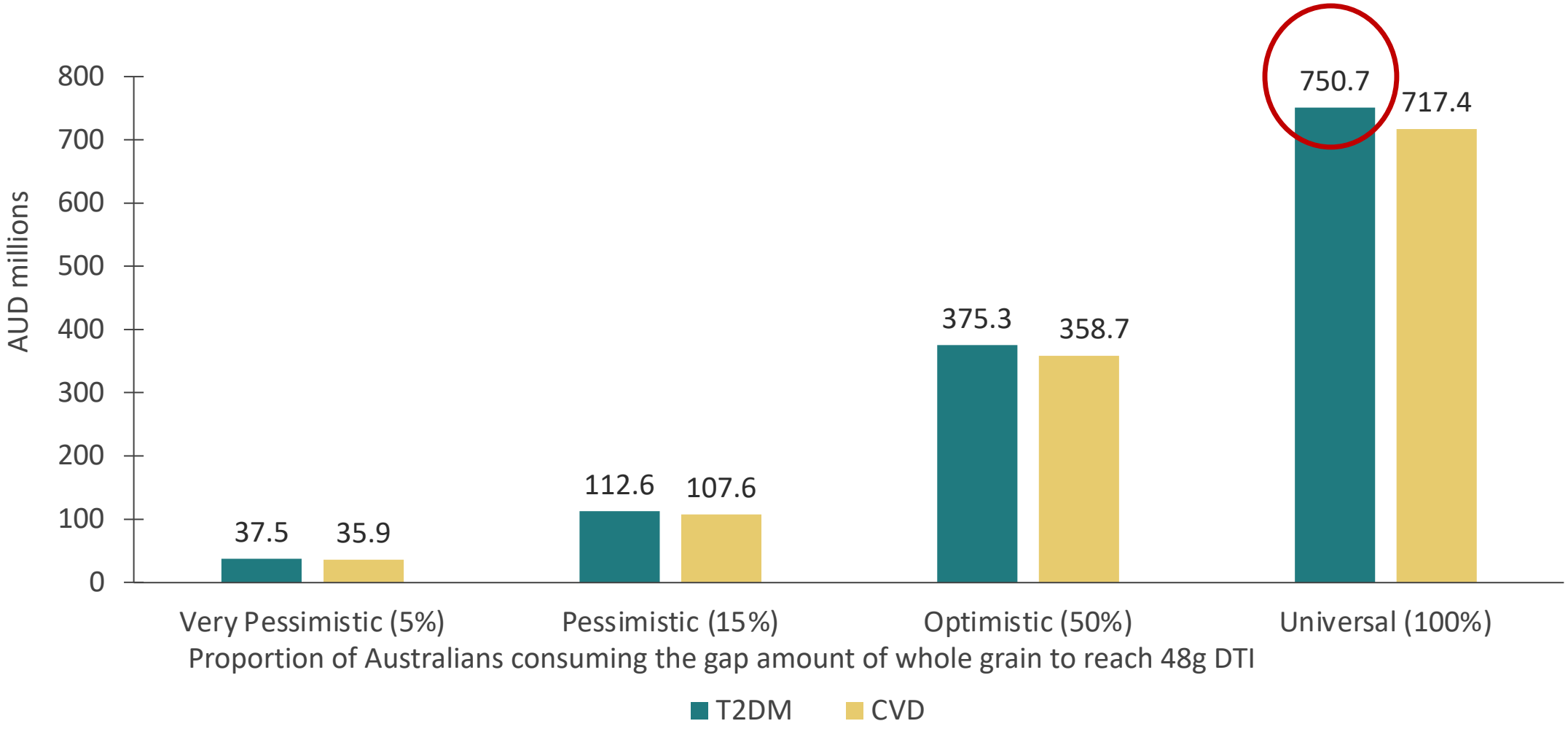
Results

Potential annual savings in direct healthcare and lost productivity costs of T2DM and CVD in Australian adults from whole grain intakes (AUD millions)



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$1.4 billion in healthcare cost savings…

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Discounted Rate

- The discount rate is defined as the interest rate that converts future monetary figures into present values.

A dollar today is worth less tomorrow…

- The Australian Government recommends the appropriate rate to use*
- A real discount rate of 7% was applied to the total savings in T2DM and CVD cost data, separately.

*Australian Government 2007. Best Practice Regulation Handbook. Available online: http://regulationbodyofknowledge.org/wp-content/uploads/2013/03/AustralianGovernment_Best_Practice_Regulation.pdf (accessed on 29 June 2021).

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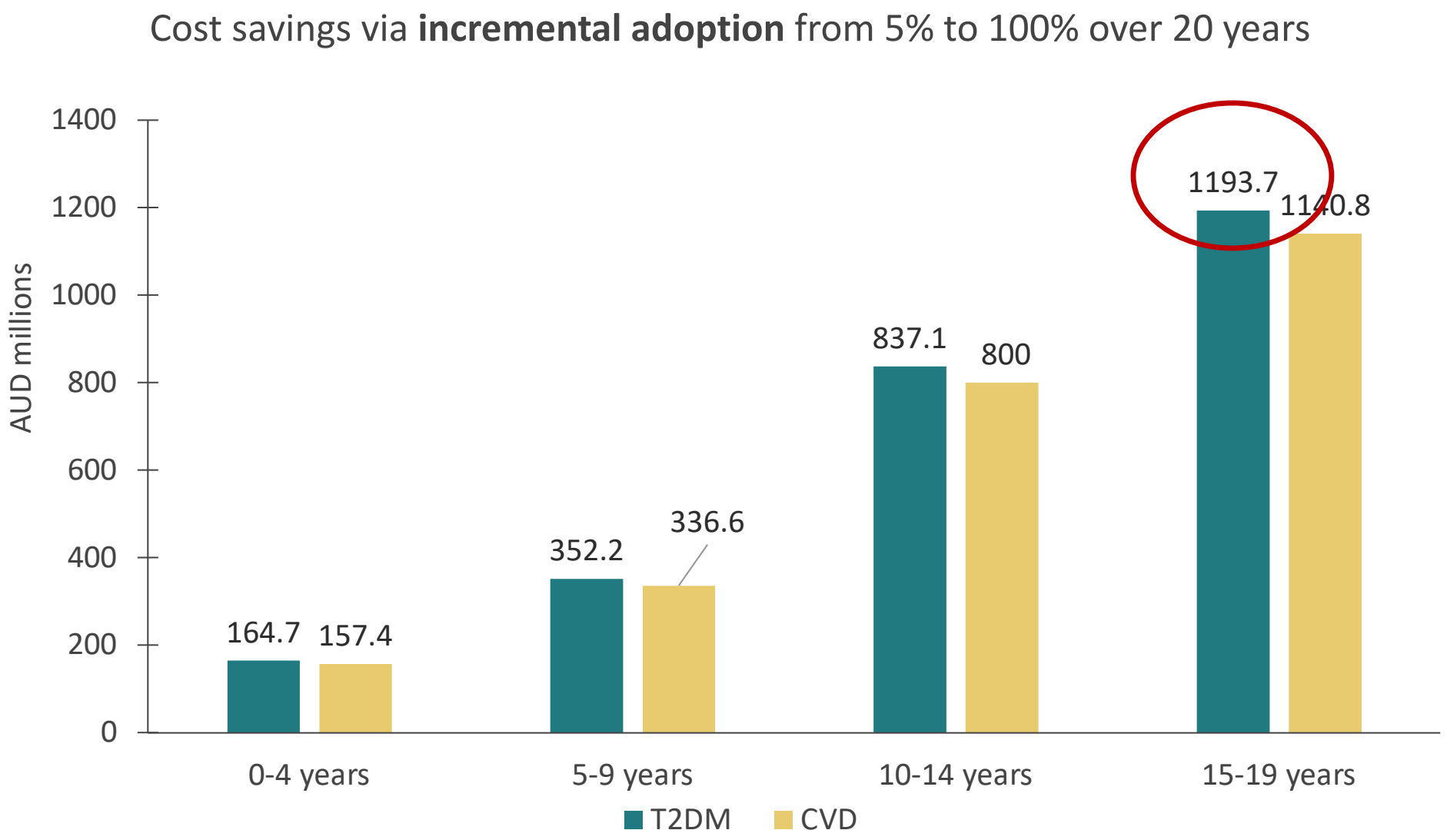
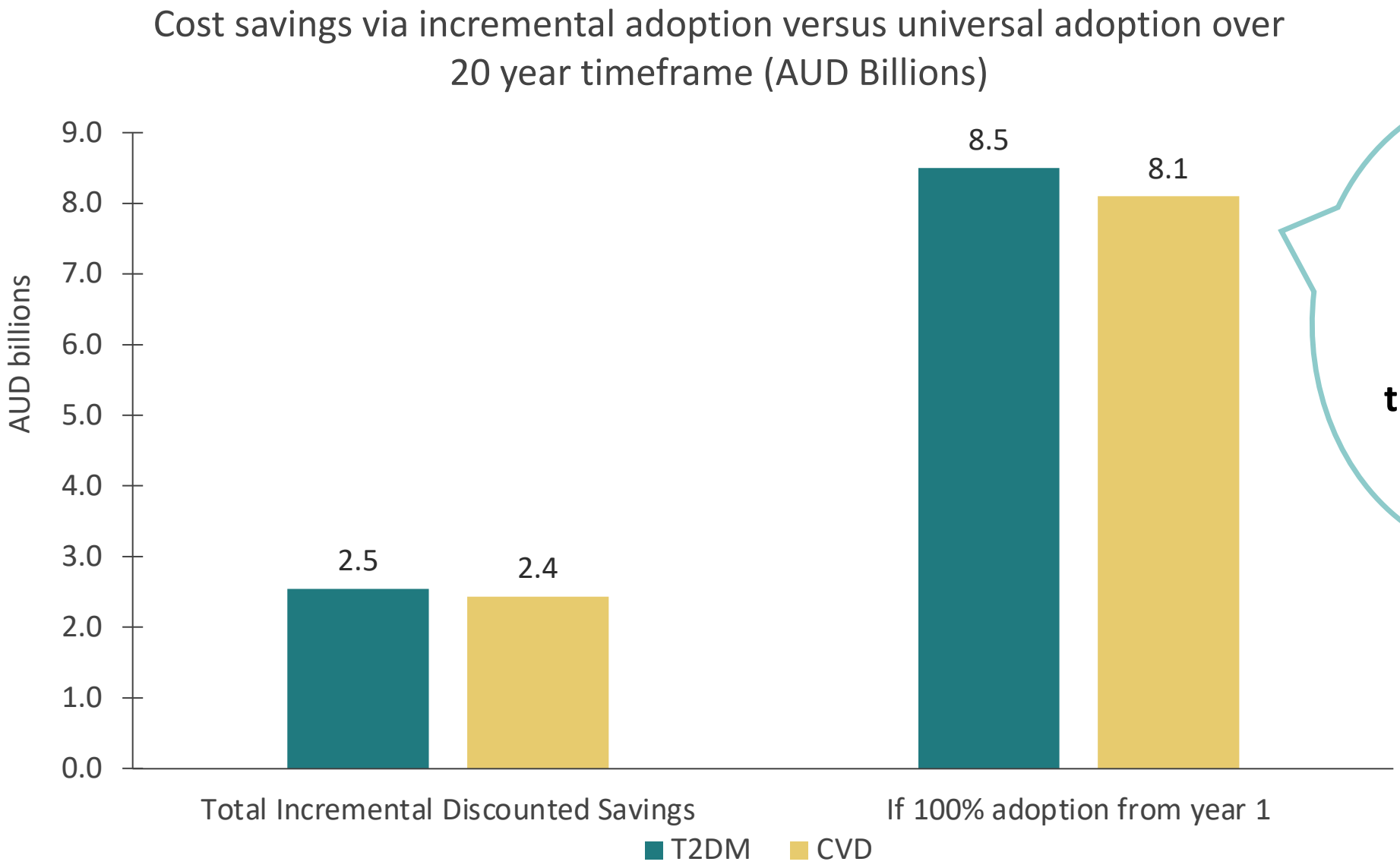
Results: Discounted Rate



Results



Immediate universal adoption would triple the healthcare cost savings.

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Communicating the Results…

Versus

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Finnish Study: Modelled Scenarios

TYPE 2 DIABETES-RELATED HEALTH ECONOMIC IMPACT ASSOCIATED WITH INCREASED WH GRAINS CONSUMPTION AMONG ADULTS IN FINLAND.

Dr. Janne Martikainen

Estimate **the T2D-related expected savings* potential and QALY gains** achieved through consumption of whole grains in the Finnish population *without* pre-existing T2D.

Scenario	Current Situation		Scenarios	
	Proportion of whole grain consumers (%)	Number of whole grain servings (n)	Proportion of whole grain consumers (%)	Number of whole grain servings (n)
1	70	1	80	1
2	70	1	70	2
3	70	1	80	2

* The savings potential estimates consider changes in both direct health care and productivity costs related to functional and work capacity.

**Whole grains shall consist of the intact, ground, cracked, flaked or otherwise processed kernel after the removal of inedible parts such as the hull and husk. All anatomical components, including the endosperm, germ, and bran must be present in the same relative proportions as in the intact kernel (Whole Grain Initiative 2020)

sh Study: Whole Grain and Diabetes

Economics:

Type-2 Diabetes related costs among Finnish adult (30-79 years) with diabetes almost € 8.3 billion in 10 year or € 22.4 billion in 20 years.

Quality of Life:

80,900 to 276,137 QALYs (Quality Adjusted Life Years) could be gained at the population level due to decreased T2D-related morbidity and mortality at the population level

Finland · Population, total

5.52 million (2019)

About equal to the population of Colorado

Estimated savings: € 0.3 to 4.2 billion

Finnish Study: Whole Grain and Diabetes

Finland · Population, total

5.52 million (2019)

About equal to the population of Colorado

Extrapolate

USA – Population, total

328.2 million (2019)

59 Times Finland's population

Estimated savings: € 0.3 to 4.2 billion

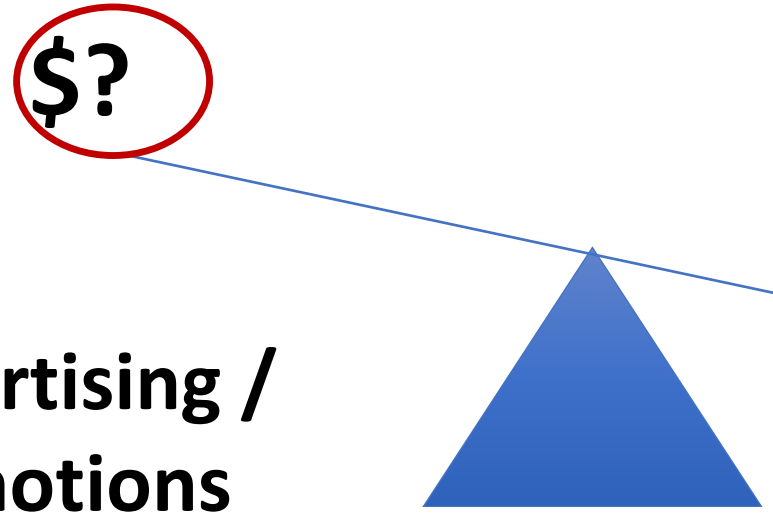
American Diabetes Association estimate

Direct medical costs: $237 billion

Reduced productivity: $90 billion

1 Serving WG: $64 billion Direct savings

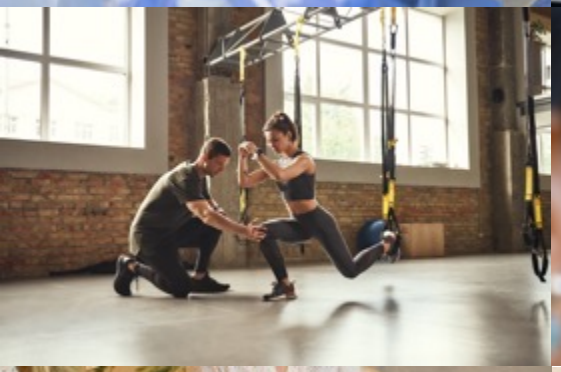
2 Servings WG: $83 billion Direct savings















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Clients are increasingly complex

Consults via technology due to COVID

Physical & Mental health issues

Medications & shortages (GLP-1 agonists)

Cross-disciplinary management needed

Long-term management and care

Long-term lifestyle & behaviour change issues

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Why prioritise whole grains?

1. **Prevention** of disease…
   - T2DM, CVD, Colorectal Cancer

2. **Management** of disease
   - All clients with Diabetes are more at risk for CVD
   - RCT evidence appears heterogeneous with different grains exerting different effects
   - Oats (?barley) via β-glucan helps lower total cholesterol, & LDL-cholesterol
   - Brown rice – lowers triglycerides
   - Glycaemic control – different grains; porridge v overnight oats

(Marshall et al, 2020)

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Is it a realistic change for clients?

- No need to increase energy intake
- Simple swaps…
- Core food in the diet… and many diets globally
- Cost effective measure – products generally at price parity
- If consumers select a bread very high in whole grain – they can meet the 48g daily target intake
- Gluten free whole grains are available

How Much Whole Grain is Enough?

Experts recommend eating six servings of grain per day, at least three of which are whole grain.

A serving* of grain is any of the following: one slice of bread; a half cup of cooked oatmeal, pasta or rice; an ounce of crackers; or a cup of dry cold cereal. These pictures show how easy and delicious it can be to get three or more servings of whole grain each day.

1 cup oatmeal 2 servings of whole grain	a sandwich 2 servings of whole grain	½ cup brown rice 1 serving of whole grain
1 whole wheat English muffin 2 servings whole grain	3 cups popcorn 1 serving of whole grain	1 cup 50% whole grain pasta 1 serving of whole grain
1 cup whole grain cereal 1 serving of whole grain	½ round whole wheat pita 1 serving whole grain	1 cup cooked quinoa 2 servings of whole grain

** a serving of grain is also sometimes called an "ounce equivalent" because it equals about the amount of food that weighs an ounce.*

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Whole grain well represented across grain food categories..

67% of breakfast cereals = whole grain (≥8g/serve)

25% of breads

66% of grain based muesli bars

19% of flour products

22% of savoury crackers

20% of grains/pasta/noodles

Back in Time for Breakfast: An Analysis of the Changing Breakfast Cereal Aisle

by Emilie Croisier [1], Jaimee Hughes [2], Stephanie Duncombe [1,3] and Sara Grafenauer [2,4,*]

Comprehensive Nutrition Review of Grain-Based Muesli Bars in Australia: An Audit of Supermarket Products

by Felicity Curtain [1,*] and Sara Grafenauer [1,2]

Flour for Home Baking: A Cross-Sectional Analysis of Supermarket Products Emphasising the Whole Grain Opportunity

by Jaimee Hughes [1], Verena Vaiciurgis [2] and Sara Grafenauer [1,2,*]

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What is needed at a policy level?

- Greater recognition of whole grain at a political and policy level
- Clear and direct dietary guidance – **Choose whole grain** in preference to soft language like ‘preferably’ or ‘mostly’ whole grain
- Inclusion of whole grain in front-of-pack labelling


Open Access Article

Health Star Rating in Grain Foods—Does It Adequately Differentiate Refined and Whole Grain Foods?

Felicity Curtain * and Sara Grafenauer

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2. doi:10.3390/nu11020415.

How do you spot a whole grain?

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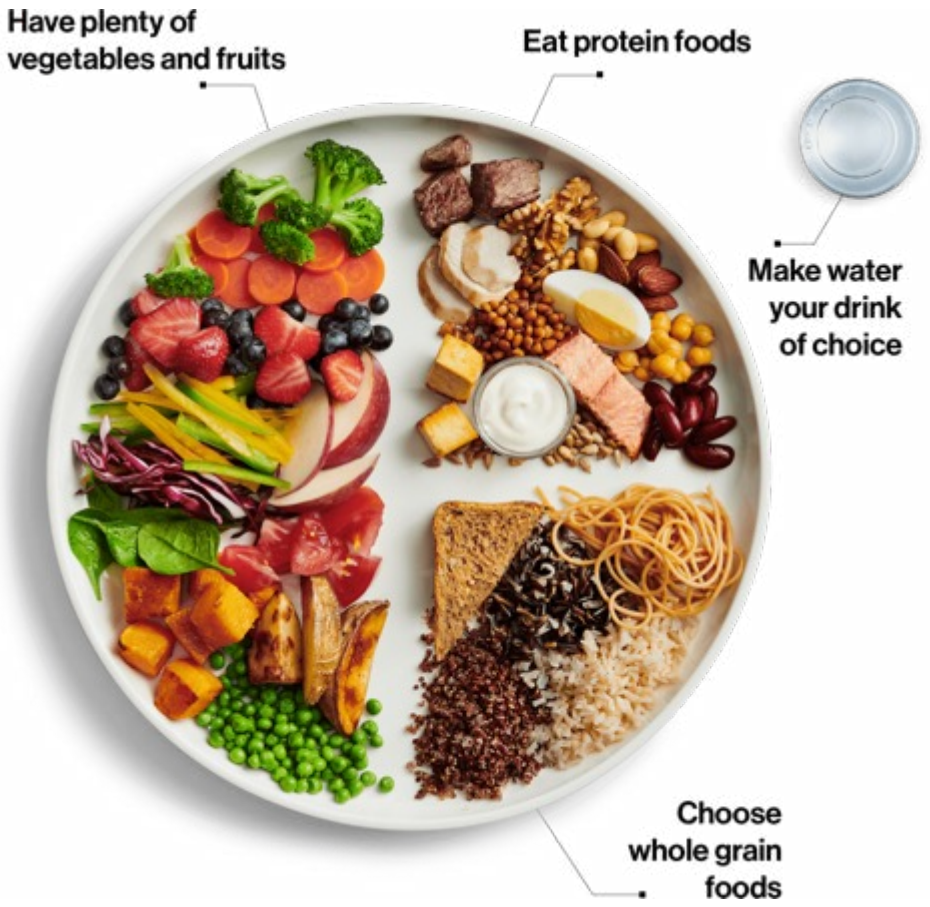
Where to next?

- Even in countries where whole grain intake is low, there are significant savings… and health outcome benefits
- Simple communication messages: SWAP
- Swapping an additional 1-2 slices of a high in whole grain / wholemeal bread or consuming a whole grain breakfast cereal would meet or exceed the 48g target



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Thank you

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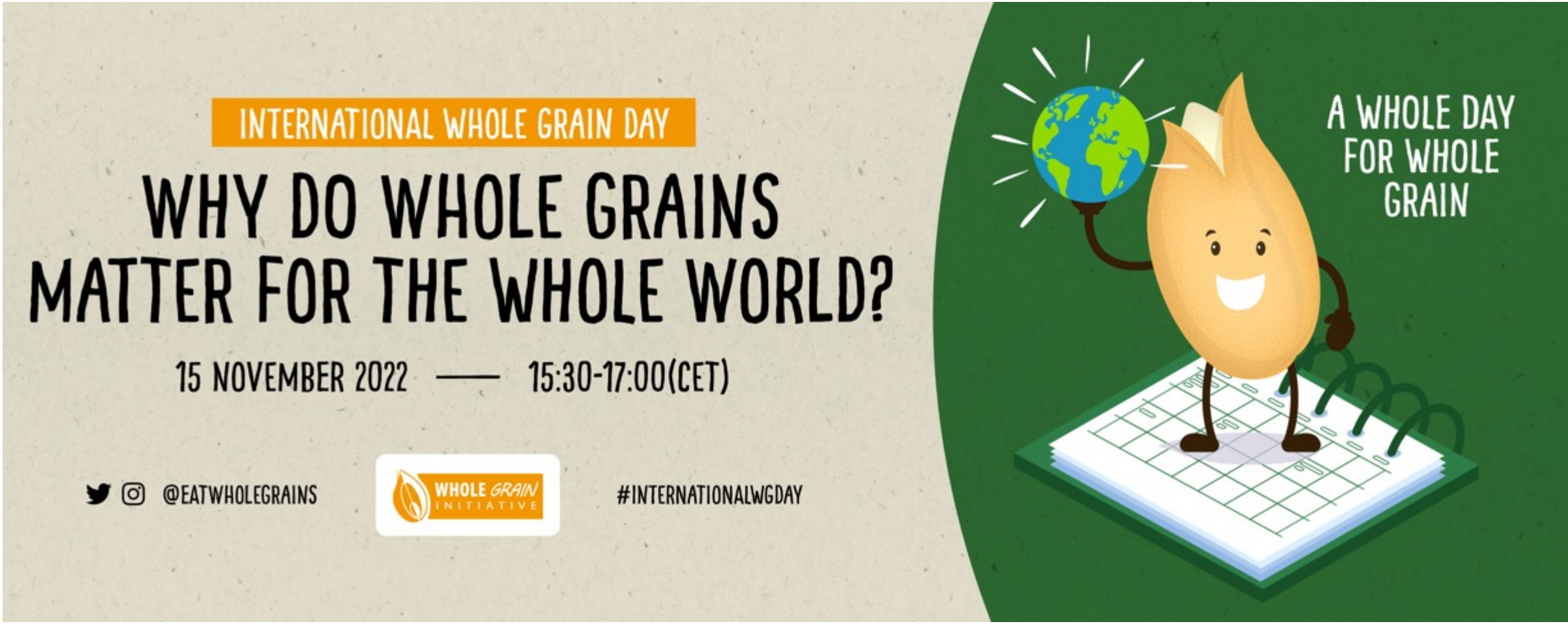

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Questions?

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