WHOLE GRAIN:
THE IMPORTANCE IN THE DIET

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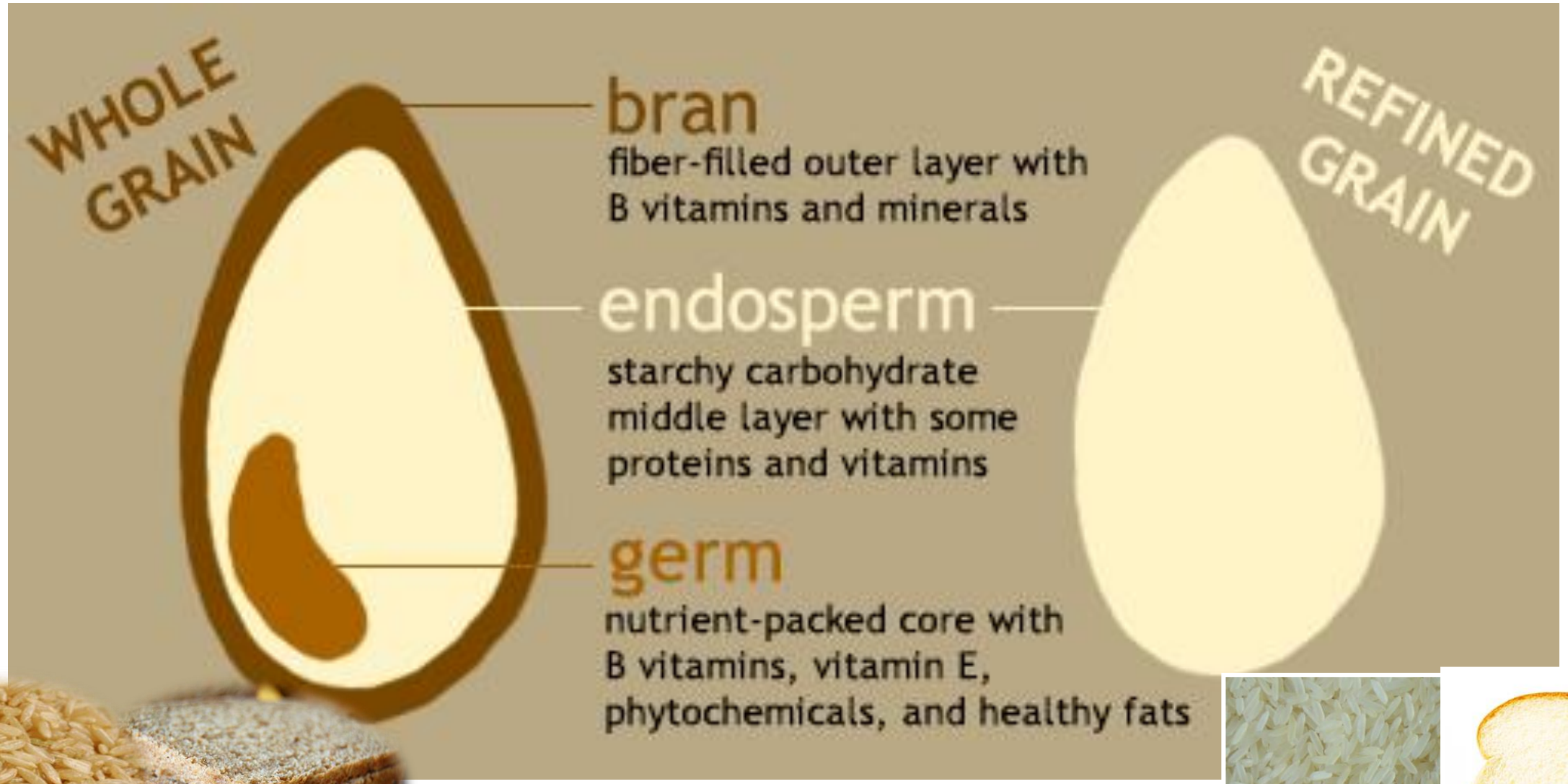
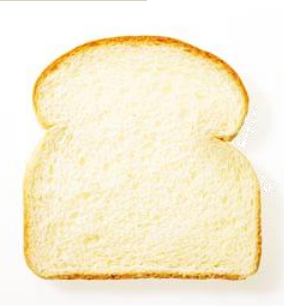
2019

Grains

- are the primary source of carbohydrates needed to provide fuel for the body
- are the largest source of energy in almost all diets worldwide.

Grains


WHOLE GRAIN
bran
fiber-filled outer layer with B vitamins and minerals
endosperm
starchy carbohydrate middle layer with some proteins and vitamins
germ
nutrient-packed core with B vitamins, vitamin E, phytochemicals, and healthy fats
REFINED GRAIN



Refined vs Whole Grains

Refining grains

causes major loss of nutrients and fibre, which has important health implications.

Has **one part** of the grain (endosperm)

Low in fiber because the bran has been removed

Low in vitamins, minerals, and antioxidants because the germ has been removed

Whole grains

are rich in dietary fiber, vitamins, minerals, phytochemicals, and other bioactive compounds that may jointly favor long-term health

Has **all three parts** of the grain (Bran, germ, endosperm)

High in fiber because the bran is intact

High in vitamins, mineral, and antioxidants because the germ is intact

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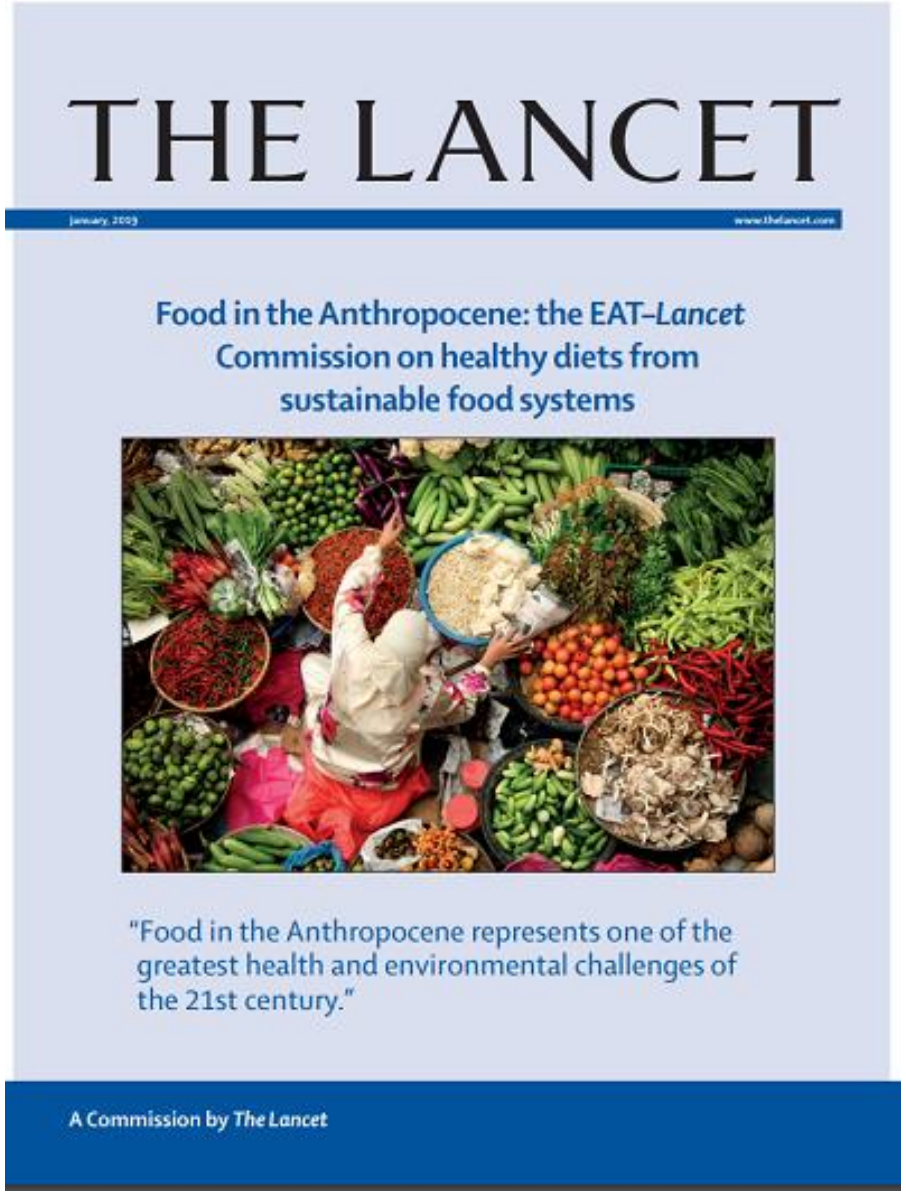
Components have various effects on our bodies:

- **Bran and fiber** slow the breakdown of starch into glucose—thus maintaining a steady blood sugar rather than causing sharp spikes.
- **Fiber** helps lower cholesterol as well as move waste through the digestive tract.
- **Fiber** may also help prevent the formation of small blood clots that can trigger heart attacks or strokes.
- **Phytochemicals and essential minerals** such as magnesium, selenium and copper found in whole grains may protect against some cancers.

https://www.hsph.harvard.edu/nutritionsource/what-should-you-eat/whole-grains/

FOOD IN THE ANTHROPOCENE:

The Eat-lancet Commission on Healthy Diets from Sustainable Food Systems



Refined grain – Health outcomes

- Few studies have examined associations between total or refined grains and health outcomes,
- Refined grains are a major source of high-glycaemic carbohydrates, which have adverse metabolic effects and are associated with increased risk of metabolic abnormalities, weight gain, and cardiovascular disease
- In a prospective international study, done mainly in low-income and middle-income countries, total carbohydrate intake accounting for more than 60% of energy, was associated with increased total mortality.

Willet et al, Lancet, 2019; Mozaffarian, *N Engl J Med 2011; Hu, AJCN 2010* ; Dehghan, Lancet, 2017; Appel, JAMA 2005

R Agustina, 2019

Refined grain – Health outcomes

- In controlled feeding studies, high carbohydrate intake increases blood triglyceride concentration, reduces HDL cholesterol concentration, and increases blood pressure, especially in individuals with insulin resistance.
- These findings are of global significance because declining levels of physical activity and increasing adiposity will raise insulin resistance and exacerbate these metabolic responses to carbohydrate intake, and thus increase the risk of cardiovascular disease and diabetes.

Willet et al, Lancet, 2019

Whole grain – NCDs risk -,Mortality

In many studies and with remarkable consistency,

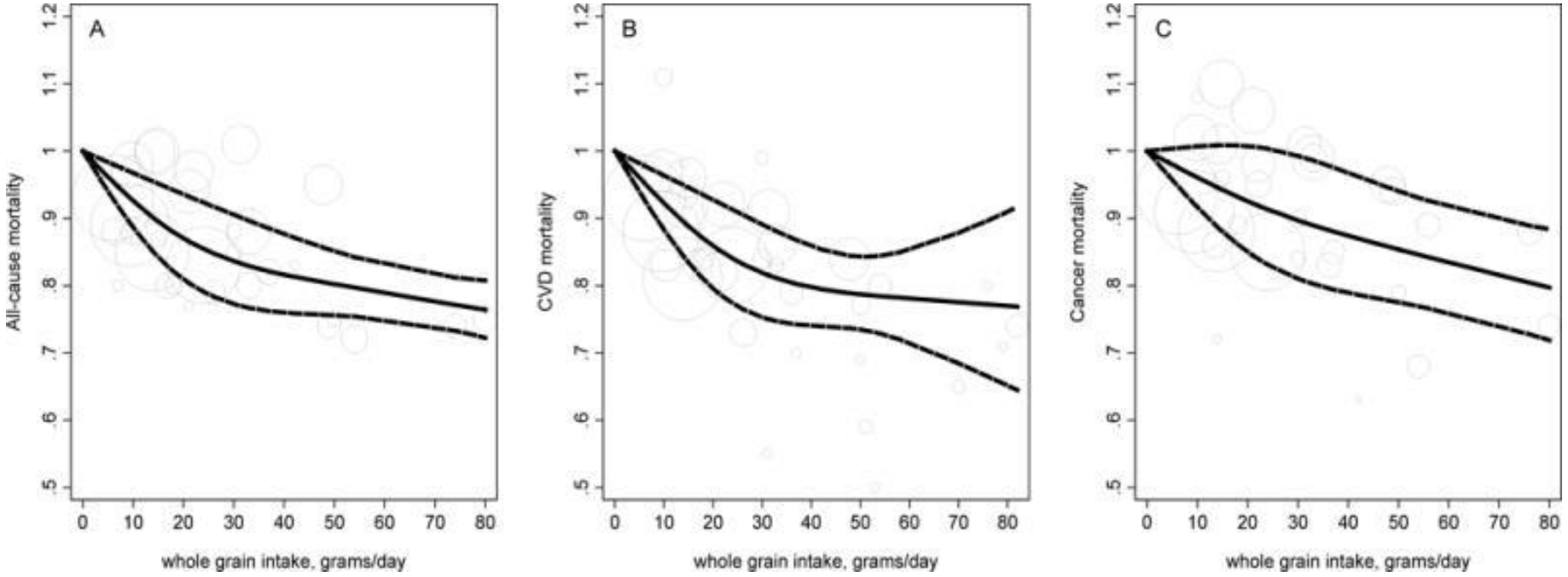
High intake of whole grains and fibre from grain sources has been associated with **reduced risk of**

- **coronary heart disease,**
- **type 2 diabetes, and**
- **overall mortality.**

Willet et al, Lancet, 2019 ; Zong, Circulation 2016

Whole grain – Overal mortality

- **Iowa Women's Health Study** linked whole grain consumption with fewer deaths from inflammatory and infectious causes, excluding cardiac and cancer causes.
- Compared with women who rarely or never ate whole-grain foods, those who had at least **two or more servings a day** were 30% less likely to have died from an inflammation-related condition over a 17-year period



Zong, Circulation 2016

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Whole grain intake - # of death

	Whole-grain food intake (servings/wk)					P for trend
Cause of death	Q1 (0–3.5)	Q2 (4–7)	Q3 (7.5–10.5)	Q4 (11–18.5)	Q5 (≥19)	
Total death	1288	1089	1149	1041	985	—
CVD	432	404	375	376	313	—
CHD	233	229	209	193	170	—
Stroke	89	80	81	86	78	—
Iintracranial hemorrhagic stroke	17	23	27	21	25	—
nonhemorrhagic stroke	59	45	45	53	49	—
Cancer	480	393	448	387	391	—
noncardiovascular, noncancer, inflammatory diseases	291	188	223	183	187	—
noncardiovascular, noncancer, noninflammatory diseases	85	105	103	95	94	

Jacobs, AJCN 2007

Whole-grain consumption is associated with a reduced risk of noncardiovascular, noncancer death attributed to inflammatory diseases in the Iowa Women's Health Study1

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A meta-analysis

- combining results from studies conducted in the U.S., the United Kingdom, and Scandinavian countries (which included health information from over 786,000 individuals),
- found that people who ate 70 grams/day of whole grains—compared with those who ate little or no whole grains—
- had a 22% lower risk of total mortality, a 23% lower risk of cardiovascular disease mortality, and a 20% lower risk of cancer mortality.
- Willet, Lancet 2019

Cardiovascular Disease

- Eating whole instead of refined grains substantially lowers total cholesterol, low-density lipoprotein (LDL, or bad) cholesterol, triglycerides, and insulin levels

Cardiovascular Disease

- **Harvard-based Nurses' Health Study**,
  - There was a strong inverse association between whole-grain intake and risk of CHD
  - women who ate 2 to 3 servings of whole-grain products each day were 30% less likely to have a heart attack or die from heart disease over a 10-year period than women who ate less than 1 serving per week.
- **A meta-analysis of seven major studies** showed that cardiovascular disease (heart attack, stroke, or the need for a procedure to bypass or open a clogged artery) was 21% less likely in people who ate 2.5 or more servings of whole-grain foods a day compared with those who ate less than 2 servings a week

Liu, AJCN, 1999; Mellen, *Nutr Metab Cardiovasc Dis*. 2008

Type 2 Diabetes

- Replacing refined grains with whole grains and eating at least 2 servings of whole grains daily may help to reduce type 2 diabetes risk.
- The fiber, nutrients, and phytochemicals in whole grains may improve insulin sensitivity and glucose metabolism and slow the absorption of food, preventing blood sugar spikes.
- In contrast, refined grains tend to have a high glycemic index and glycemic load with less fiber and nutrients.

Aune et al, *Eur J Epidemiol*. 2013

Type 2 Diabetes

- In a study of more than 160,000 women whose health and dietary habits were followed for up to 18 years, those who averaged 2 to 3 servings of whole grains a day were 30% less likely to have developed type 2 diabetes than those who rarely ate whole grains.
- When the researchers combined these results with those of several other large studies, they found that eating an extra 2 servings of whole grains a day decreased the risk of type 2 diabetes by 21%.

De Munter et al, *PLoS Med*. 2007

Type 2 Diabetes

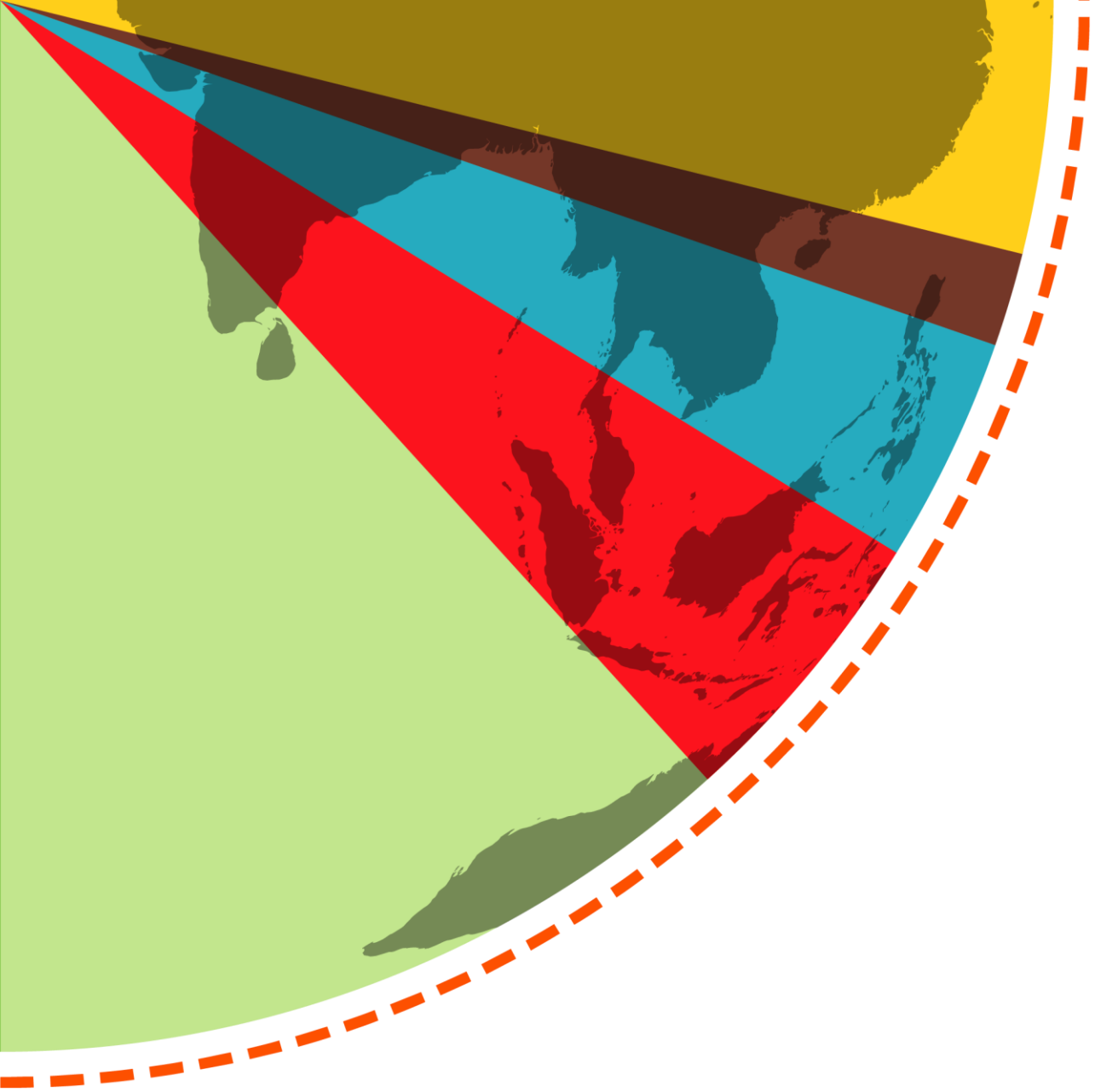
- the Nurses' Health Studies I and II and the Health Professionals Follow-Up Study (men and women)
  - Those who ate the most **white rice—five or more servings a week—had a 17% higher risk of diabetes** than those who ate white rice less than one time a month.
  - Those who **ate the most brown rice—two or more servings a week—had an 11% lower risk of diabetes** than those who rarely ate brown rice.
  - Swapping whole grains in place of even some white rice could lower diabetes risk by 36%.

Sun, *Arch Intern Med*. 2010; Parker *Ann Epidemiol*. 2013

Type 2 Diabetes

- A large study of more than 72,000 postmenopausal women without diabetes at the start of the study found that the **higher the intake of whole grains, the greater the risk reduction of type 2 diabetes**.
  - A 43% reduced risk was found in women eating the highest amount of whole grains (2 or more servings daily) as compared with those who ate no whole grains.

Sun, *Arch Intern Med*. 2010; Parker *Ann Epidemiol*. 2013



The EAT-*Lancet* Commission on
Healthy Diets From
Sustainable Food Systems

Food Planet Health

How much grain

- Evidence does not suggest a specific proportion of energy intake from carbohydrates, but keeping this to <60% of energy appears desirable and consumption of whole grains is emphasised.
- Thus, **232 g/day of whole grains** and **50 g/day of tubers** and starchy vegetables with a limit of **100 g/day of tubers and starchy vegetables**)

Willet, Lancet, 2019

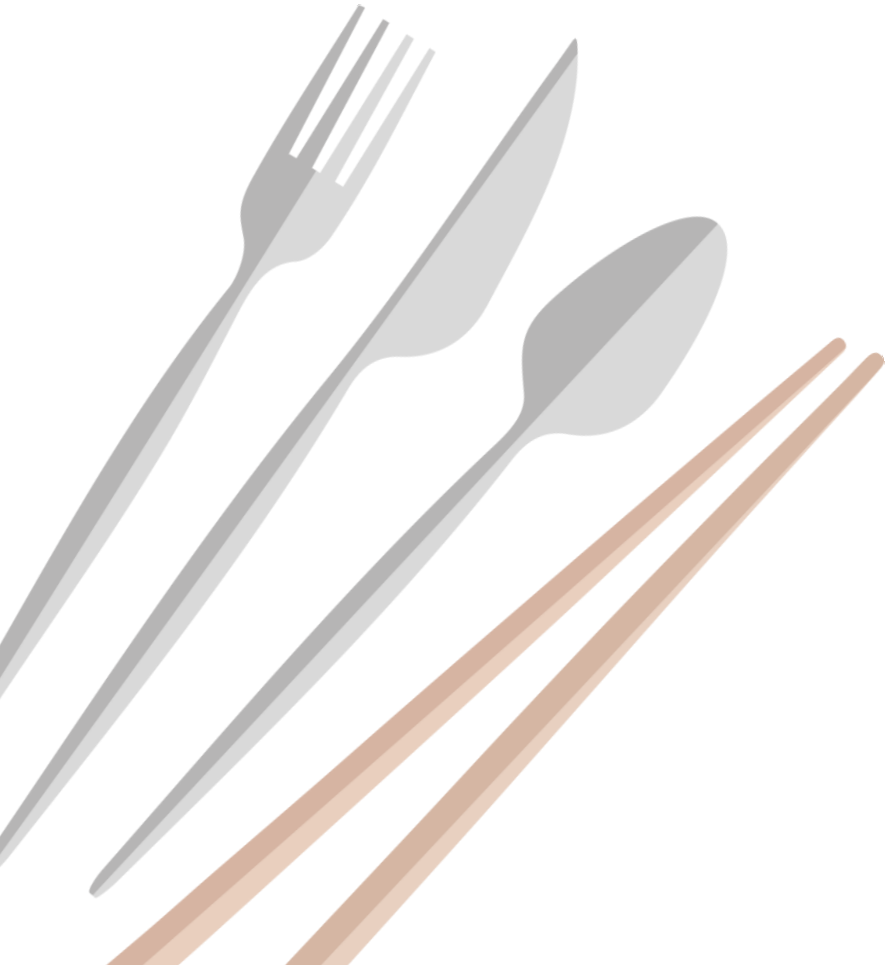
R Agustina, 2019

Whole GRAIN SOURCES

- **WHOLE WHEAT**
- **BROWN RICE**
- **OATS**
- **BARLEY**
- **WILD RICE**
- **CORN**

Target 1 – Healthy Diets

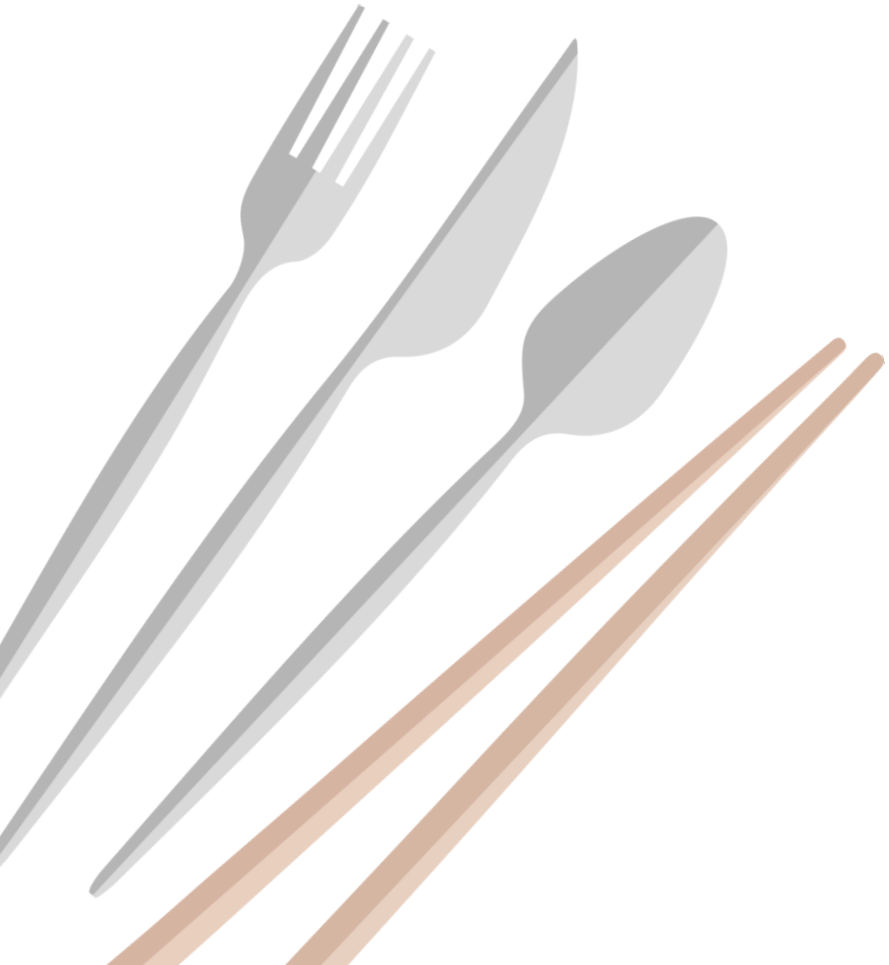
2500 kcal/day

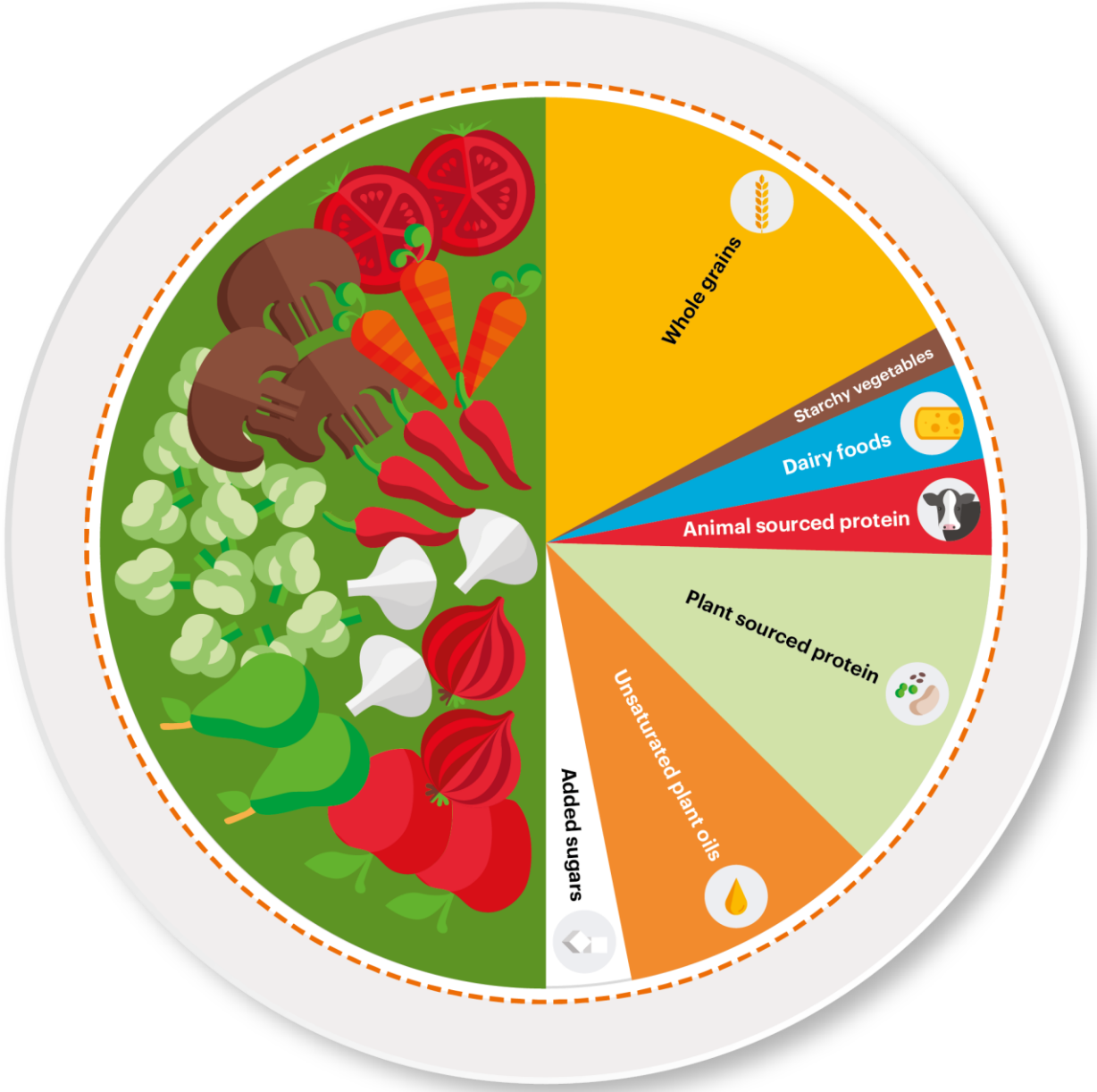


	Macronutrient intake grams per day (possible range)	Caloric intake kcal per day
Whole grains		
Rice, wheat, corn and other	**232**	**811**
Tubers or starchy vegetables		
Potatoes and cassava	**50** (0–100)	**39**
Vegetables		
All vegetables	**300** (200–600)	**78**
Fruits		
All fruits	**200** (100–300)	**126**
Dairy foods		
Whole milk or equivalents	**250** (0–500)	**153**
Protein sources		
Beef, lamb and pork	**14** (0–28)	**30**
Chicken and other poultry	**29** (0–58)	**62**
Eggs	**13** (0–25)	**19**
Fish	**28** (0–100)	**40**
Legumes	**75** (0–100)	**284**
Nuts	**50** (0–75)	**291**
Added fats		
Unsaturated oils	**40** (20–80)	**354**
Saturated oils	**11.8** (0-11.8)	**96**
Added sugars		
All sugars	**31** (0–31)	**120**

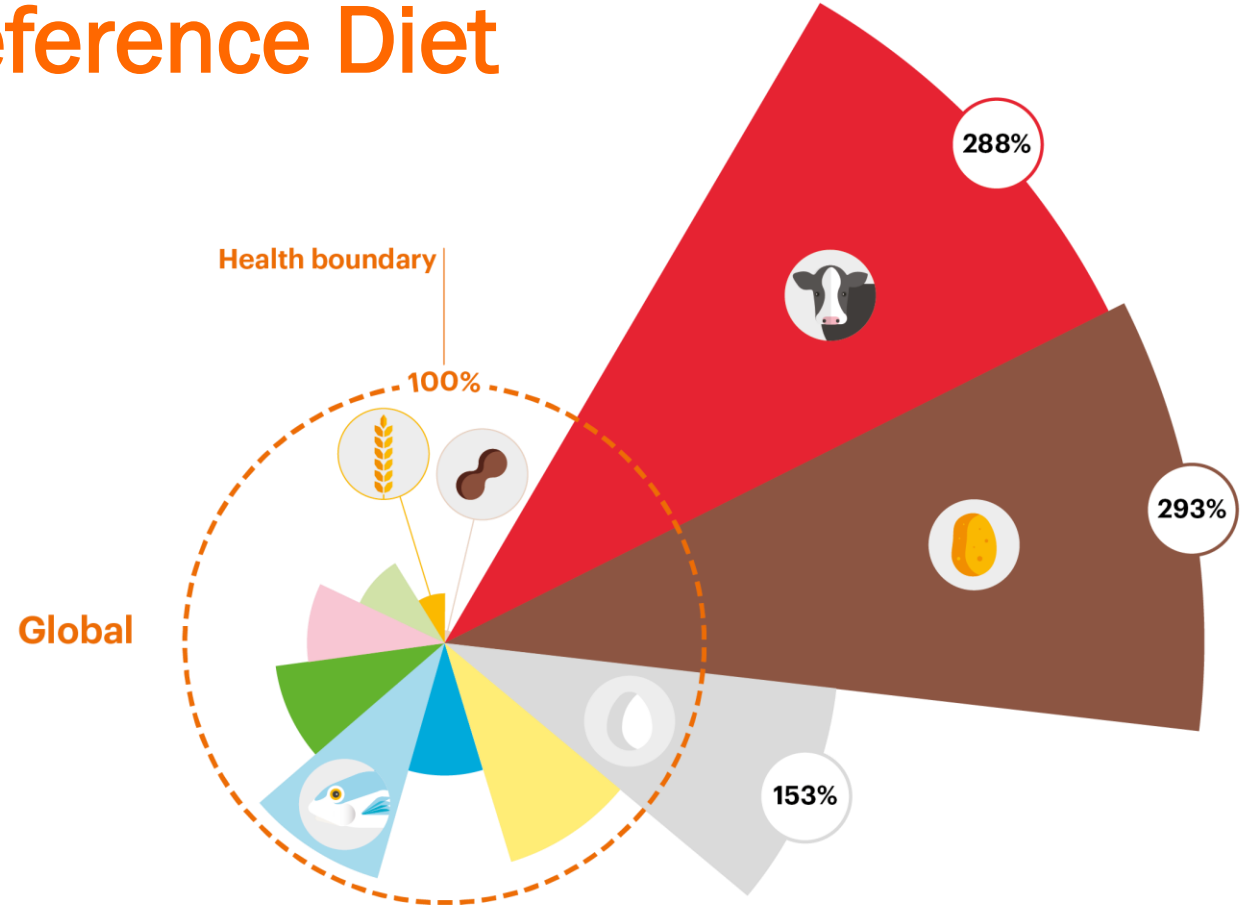
Target 1 – **Healthy Diets**

2500 kcal/day





Current Intakes vs Reference Diet



Limited intake

Optional foods

Red meat

Starchy vegetables

Eggs

Poultry

Dairy foods

Emphasized foods

Fish

Vegetables

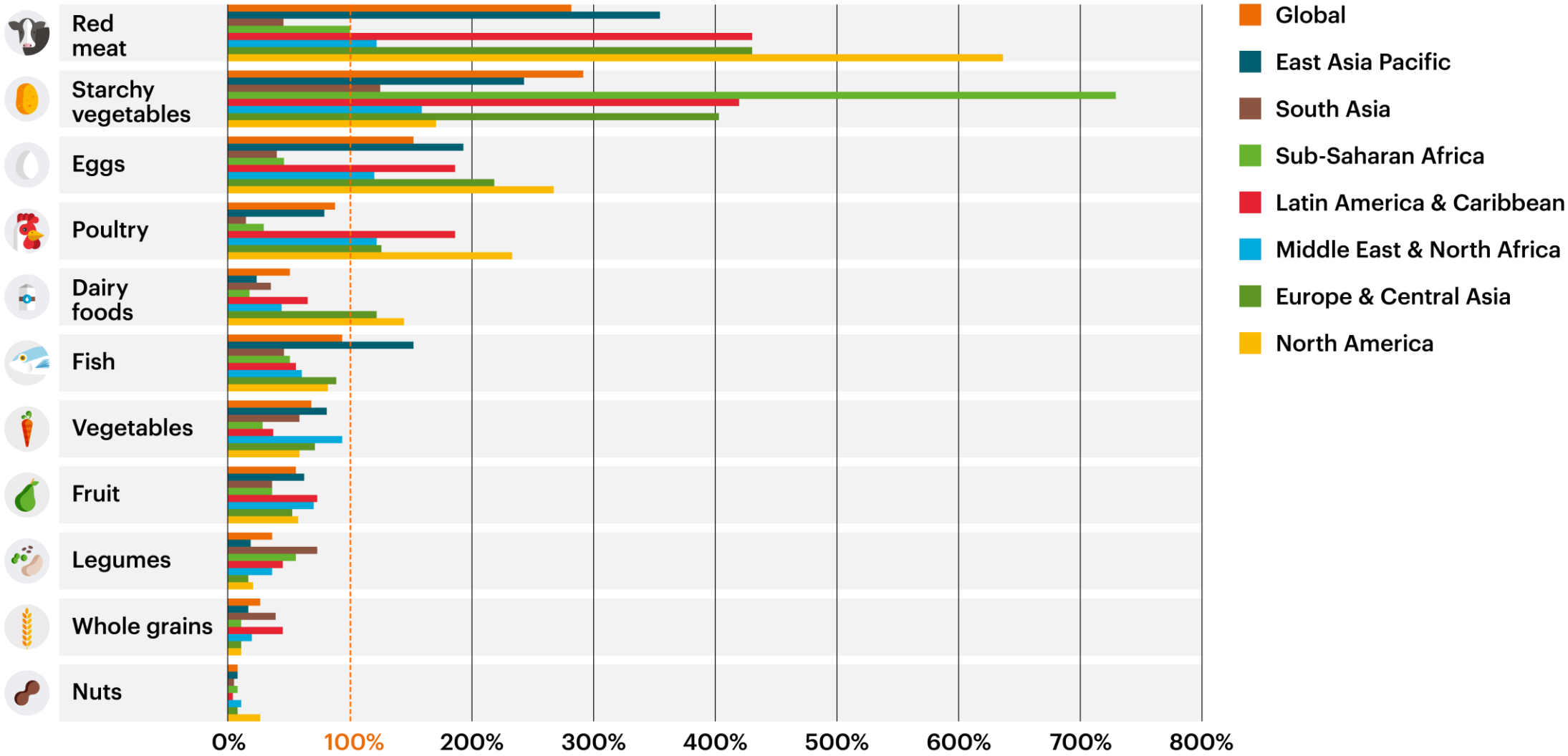
Fruit

Legumes

Whole grains

Nuts

Current Intakes vs Planetary Health Diet



Asian diets: Benefits versus Risks

Asian Diet Benefits:

- Green tea
- Rich variety of vegetables and fruits
- Spices
- Low red meat consumption
- Beans and nuts
- Fish and seafood
- **Fruits as dessert**
- Whole grains
- Tradition of controlling portion size
- Soy consumption

Asian Diet Risks:

- **White rice and other refined grains**
- Use of animal fat and palm oil
- Unhealthy trans fats (in snacks, butter, etc.) are not labelled on packages[5]
- **Sweets and snacks high in sugar**
- **Tea or coffee with too much added sugar**
- Too much salt
- Excessive consumption of preserved foods (such as pickled vegetables and cured meats)

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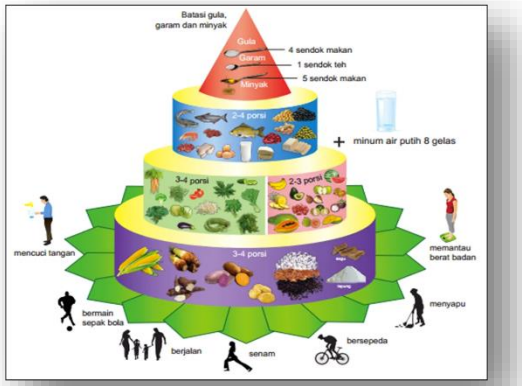
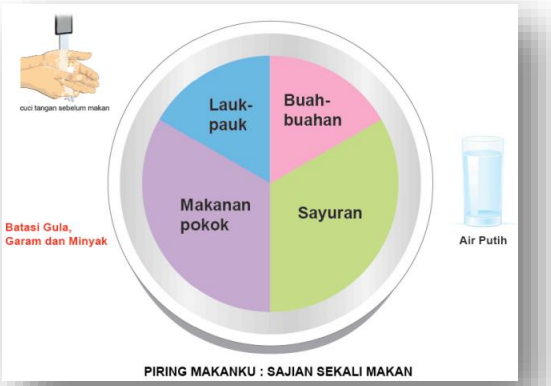
DIETARY QUALITY AND HEALTH STATUS

Indonesia MOH

Balance diet PUGS

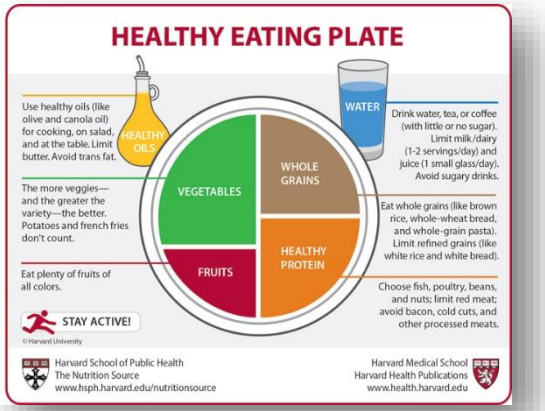




USDA

Healthy Eating Index (HEI) Dietary Quality Dietary Guidelines for American2

9 komponen *adequacy*, 3 *moderation* (0-100)



↑ **HEI** ↑ **Food Variety** ↑ **Fruit – vegetables – plant source** ↓ **Fat and saturated fat**

Rina Agustina 2018

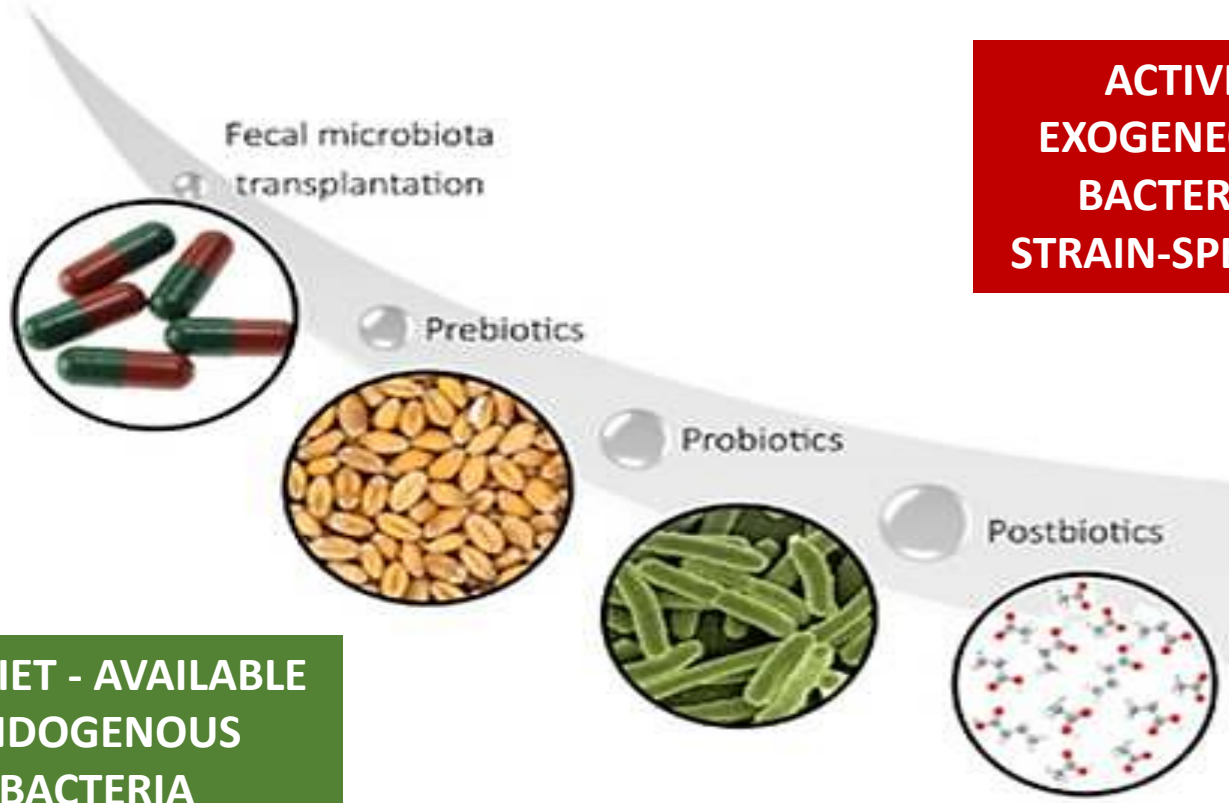
Indonesian – American Dietary Guidelines

Indonesian		Americans		Differences
Component	**Total Consumption/day**	**Component**	**Total Consumption/day**	
Calories	2150-2725 Kcal	**Calories**	2200-2800 Kcal	-
Grains, roots, and tubers	3-4 portions	**Whole grains** **Refined grains**	3.5-5 portions 3.5-5 portions	**INA DG not defined whole and refined grains**
Vegetables	3-4 portions (21-28 portions /week)	**Vegetables** **Legumes**	19-22.5 portions/week 2-2.5 portions	**INA DG recommend > vegetables - not separated vegetables with legumes**
Fruits	2-3 portions	**Fruits**	2-2.5 portions	-
Plant Protein (30%)	2-3 portions	**Nuts, seeds, soy products**	5 portions/week	**Not detailing plants protein** **INA DG not emphasize to consume dairy product in every meal**
Animal Protein (70%)	2-3 portions (21 portions/week)	**Meet+seafood** **Dairy**	37-43 portions/week 3 portions	
Oils	5-7 portions (25-35 g)	**Oils**	29-36 gram	-
Other calories	350 kkal (12%) – 400 kkal (14.5%)	**Other calories**	280 kkal (13%) – 400 kkal (14%)	**Alcohol:** **Indonesian <<< American**

INA DG=Indonesian Dietary Guidelines

Stefani and Agustina, 2018

Potential strategies aimed at modulation of the gut microbiota composition



ACTIVE EXOGENEOUS BACTERIA STRAIN-SPECIFIC

VIA DIET - AVAILABLE ENDOGENOUS BACTERIA

Vieira, et al 2016

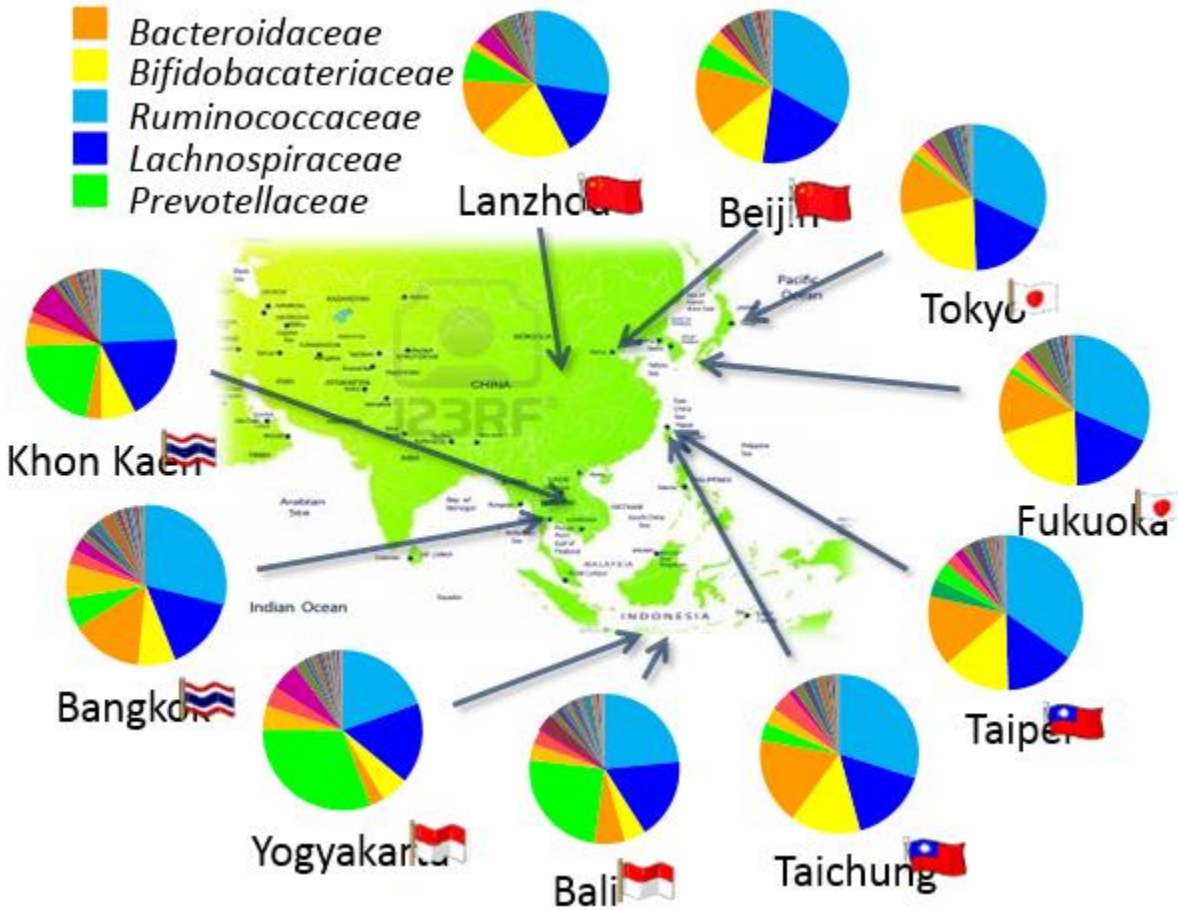
Metabolites

Psychobiotics

Nutribiotic

Pharmabiotic

Geographical, Diet and Environmental Dependent of Microbiome in Asia



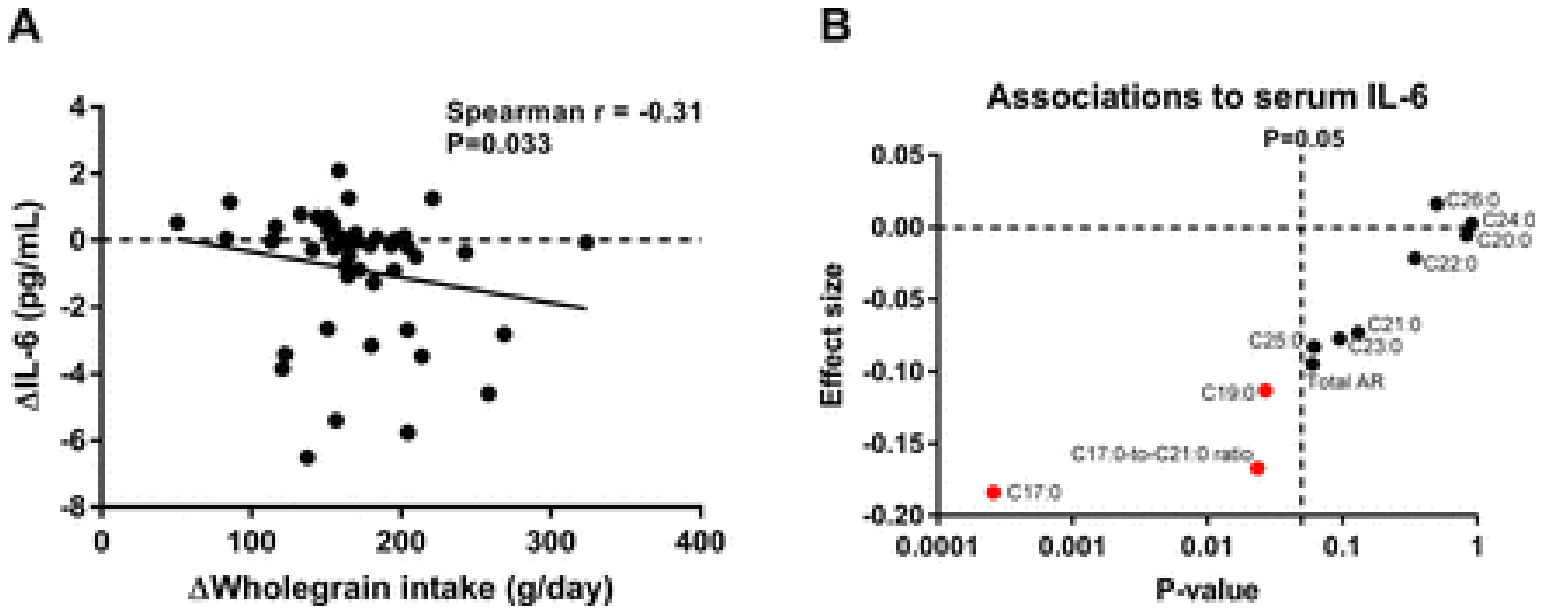
Nakayama et al 2015

Rina Agustina 2018

Whole grain and gut microbiota

- Martinez et al 2012:
- Gut microbiome composition is linked to whole grain-induced immunological improvements
- a short-term intake of whole grains induced compositional alterations of the gut microbiota that coincided with improvements in host physiological measures related to metabolic dysfunctions in humans.

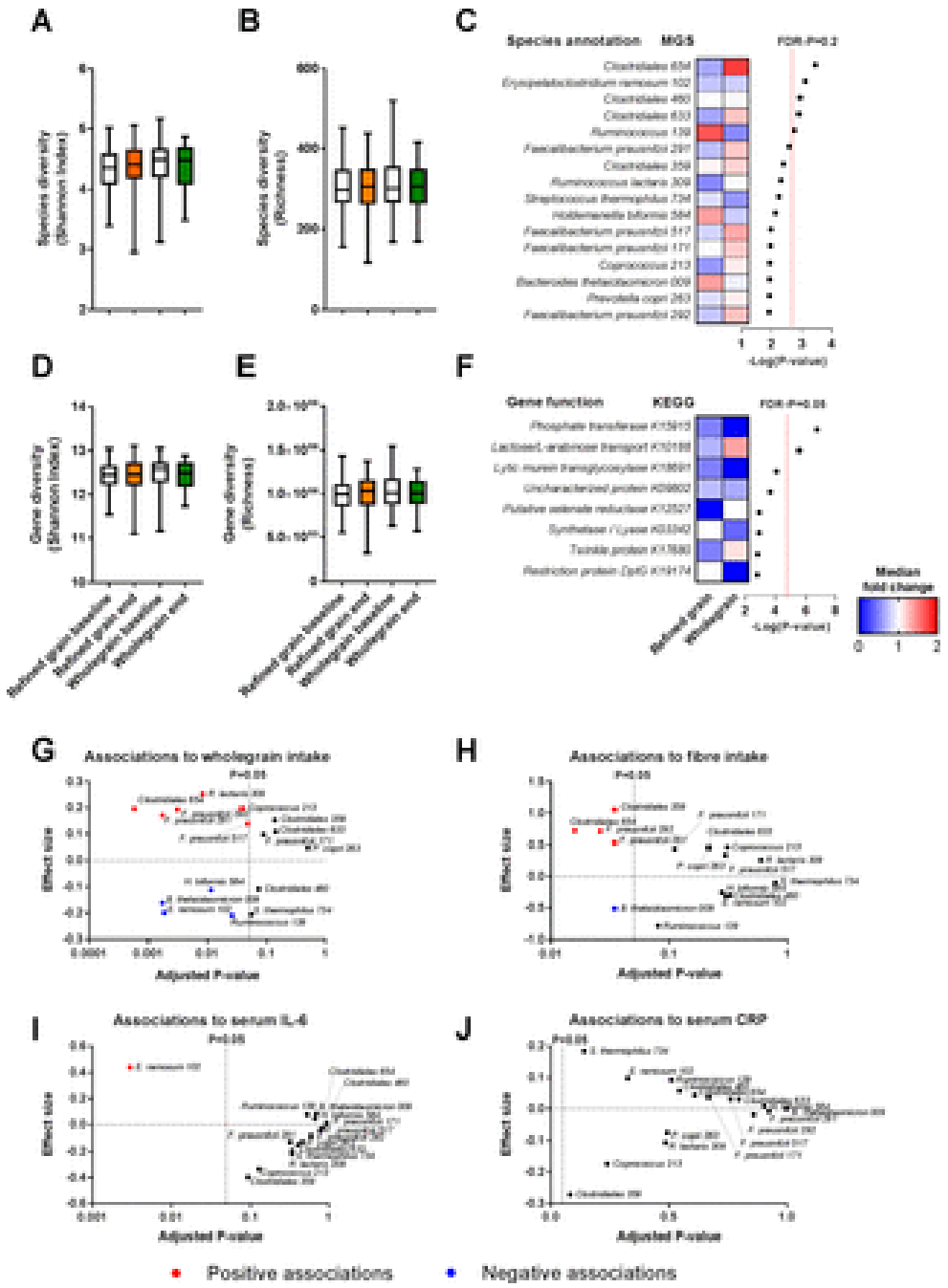
Whole grain and gut microbiota



Change in fasting serum concentrations of IL-6 was associated with whole grain intake.

- Roager , BMJ 2019
- Whole grain-rich diet reduces body weight and systemic low-grade inflammation without inducing major changes of the gut microbiome: a randomised cross-over trial
- compared with refined grain diet, whole grain diet did not alter insulin sensitivity and gut microbiome but reduced body weight and systemic low-grade inflammation.

R Agustina, 2019



Whole grain and gut microbiota

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- compared with refined grain diet, whole grain diet did not alter insulin sensitivity and gut microbiome but reduced body weight and systemic low-grade inflammation.

Indonesia intake of Grain

- Indonesia's average dietary pattern, characterized by extreme dependence on a single staple and low consumption of meat and fat, is more typical of a low-income country than of a middle-income country.
- It has among the highest energy intake shares from grains – specifically rice – in the world, exceeding those of India.
- The share of non-starchy foods in total dietary energy consumption is 30 per cent, substantially lower than the global average of 50 per cent.

PENELITIAN HIBAH KLASTER: HNRC IMERI

"DIOCHROME"

DIet bOdy composition, gut miCRObiota, Metabolic marker and Epigenetic

KUALITAS MAKAN

MIKROBIOTA USUS

OUTCOME METABOLIK DAN PENYAKIT TIDAK MENULAR

FAKTOR SOSIAL EKONOMI BUDAYA

MINANG KABAU

SUNDA

BETAWI/JAKARTA

Tionghoa

DIETARY QUALITY AND HEALTH STATUS

Concept

Dietary quality

(Healthy Eating Index or Dietary Quality Index or other Dietary Quality Assessment)

influence

Health and nutritional status

Schwingshackl et al 2018

Schwingshackl & Hoffmann, 2015

Gao, et al 2004; Hurley et al, 2009; Silva et al 2011, Shin et al 2016; Radwan 2015; Huffman 2011; Guenther, 2013

Evidence

Dietary quality

Healthy Eating Index 2010, AHEI, DASH

influence

Diets of the highest quality have been associated with a significantly lower risk of non-communicable diseases; BMI; Waist Circ
Micronutrient status

OPEN ACCESS PEER-REVIEWED

RESEARCH ARTICLE

Dietary quality of predominantly traditional diets is associated with blood glucose profiles, but not with total fecal *Bifidobacterium* in Indonesian women

Shiela Stefani, Sanny Ngatidjan, Monica Paotiana, Kurnia A. Sitompul, Murdani Abdullah, Dyah P. Sulistianingsih, Anuraj H. Shankar, Rina Agustina

Published: December 21, 2018 • https://doi.org/10.1371/journal.pone.0208815

Correction

18 Apr 2019: The PLOS ONE Staff (2019) Correction: Dietary quality of predominantly traditional diets is associated with blood glucose profiles, but not with total fecal

Healthy Eating Index Score of Minangkabau and Sundanese Women

Component	Max Score	Minangkabau (n=180)	Sundanese (n=180)	(n=360)	
Total HEI	100	35.6 ± 8.9 [a]	34.1 ± 7.2 [a]		
Component HEI: [b]					
Total fruit	5	2.0 (0.5-4.0)	1.4 (0.1-2.9)		
Whole fruit	5	2.5 (1.0-4.9)	2.1 (0.2-3.6)		
Total vegetable	5	2.6 (1.8-3.7)	2.6 (1.5-3.4)		
Greens & beans	5	1.3 (0-2.5)	1.2 (0-2.4)		
Whole grains	10	0 (0-0)	0 (0-0)		
Dairy	10	0 (0-0)	0 (0-0.01)		
Total protein foods	5	5.0 (3.9-5.0)	3.7 (2.9-5.0)		
Seafood & plant protein	5	5.0 (3.2-5.0)	3.9 (2.6-5.0)		
Fatty acids	10	0 (0-0)	0 (0-0)		
Refined grains	10	0 (0-0)	0 (0-0)		
Sodium	10	5.7 (3.5-8.6)	0 (0-4.0)	3.8 (0-6.8)	<0.001*
Empty calories	20	12.1 (7.4-16.6)	17.7 (13.9-20.0)	15.3 (10.0-19.2)	<0.001*

Poor diet (skor <51)

Perdana, dkk.
index Balance diet (IGS) : 6 food groups (carboyidrate, protein hewani, kacang-kacangan, vegetables, fruits, milk)
Women score19-55 tahun = **31,0 ± 12,1**

Hurley, dkk.
Adolescent Africa-America – low income; score HEI women= **64,5 ± 11,7** > wpmen 61,2 ± 11,6 (not different)

Differences in Metabolic

Laboratory	Minangkabau Ethnic (n=180)	Sundanese (n=180)	All Subjects (n=360)
Lipid profile	**(n=110)**	**(n=110)**	**(n=220)**
Total Kolesterol (mg/dL)	195,5 (177,0, 228,8) [a]	182,8 ± 32,8 [c]	186,5 (168,3, 212,8)*
LDL (mg/dL)	117,5 (100,0, 141,0) [a]	109,20 ± 28,7 [c]	113,5 (95,0, 135,0) *
HDL (mg/dL)	57,4 ± 10,8 [c]	49,0 (44,0, 55,8) [a]	53,0 (46,0, 61,0)*
Trigliserida (mg/dL) [a]	73,5 (60,0, 109,8)	89,0 (65,0, 124,3)	78,5 (62,0, 117,8) *
	(n=114)	**(n=114)**	**(n=228)**
AGEs (µg/mL)	1,79 (1,00, 3,68) [a]	0,79 ± 0,29 [c]	1,07 (0,83, 3,17)*

Stephany and Agustina, PLOS ONE, 2018

Differences in Metabolic Outcome

Variable	Minangkabau (n=180)	Sundanese (n=180)	All (n=360)	p
	N=180	**N=180**	**N=360**	
Fasting Blood Glucose (mg/dL)	77.0 (71.3-81.0) [a]	78.0 (71.0-84.0) [a]	77.0 (71.0-83.0) [a]	0.306[MW]
HbA1c (%)	5.5 (5.2-5.9) [a]	5.4 (5.2-5.6) [a]	5.4 (5.2-5.7) [a]	0.014*[MW]
Risk of DM [b]	14 (7,8)	10 (5,6)	24 (6,7) [CS]	
	N=120	**N=120**	**N=240**	
Intestinal Bifidobacterium (log cell/g faeces)	8.98 ± 0.69 [b]	8.73 ± 0.67 [b]	8.9 ± 0.69 [b]	0.004*[t]

an increase of one point in the HEI score will decrease FBG by 0.403 mg/dL and decrease HbA1c levels by 0.18‰.

By Rina Agustina/2018

Stephany and Agustina, PLOS ONE, 2018

Dietary quality - blood glucose profiles, total fecal *Bifidobacterium* in Indonesian women

- Low dietary quality is clearly associated with risk of increased markers of blood glucose. However, any mediating role of *Bifidobacterium* between dietary quality and glucose outcomes was not apparent. Innovative interventions for healthy eating should be implemented to increase dietary quality of populations transitioning from predominantly traditional to modern diets, to reduce the risk of diabetes, especially in women.

Stephany and Agustina, PLOS ONE, 2018

Summary

- Whole grain consumption has been associated with reduce risk of NCDs, and deaths
- Consumption of whole grain is low globally
- Improve variety of diet;
- Dietary quality – dietary guidelines
- carbohydrates primarily from whole grains with low intake of refined grains and less than 5% of energy from sugar

Samples of Planetary Health Plates





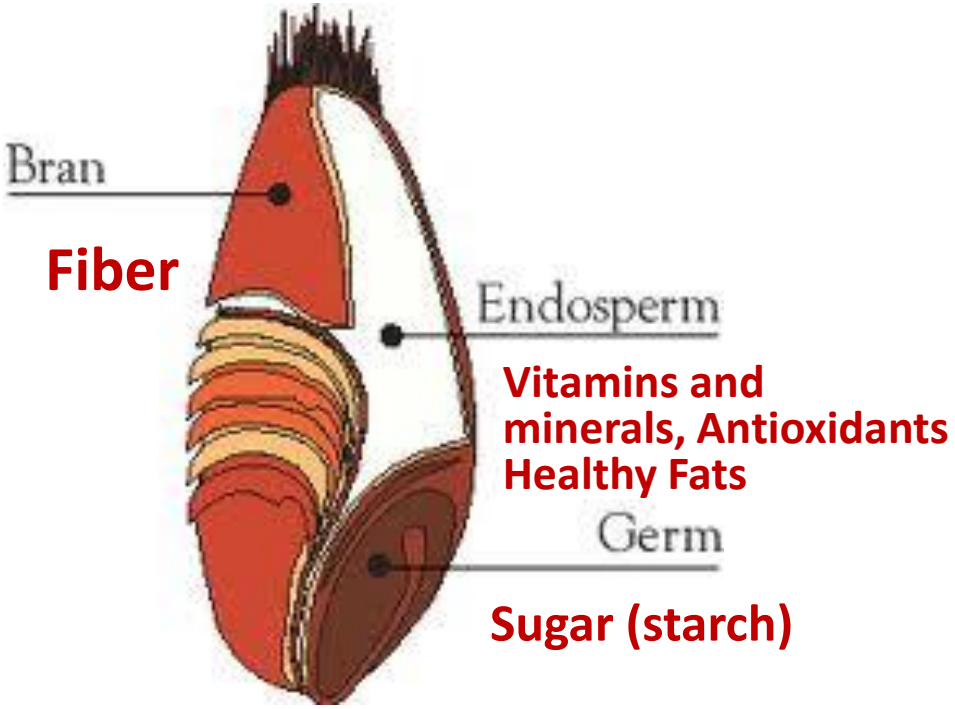



Grains

Refining grains

1.
2.
3. Endosperm

White Bread
White rice



Whole grains

1. Bran
2. Germ
3. Endosperm

Whole Wheat Bread
Brown rice

- High intake of whole grains and fibre from grain sources has been associated with reduced risk of coronary heart disease, type 2 diabetes, and overall mortality.84
- Few studies have examined associations between total or refined grains and health outcomes, but refined grains are a major source of high-glycaemic carbohydrates, which have adverse metabolic effects and are associated with increased risk of metabolic abnormalities, weight gain, and cardiovascular disease.64,85
- In a prospective international study,86 done mainly in low-income and middle-income countries, total carbohydrate intake accounting for more than 60% of energy, was associated with increased total mortality. In controlled feeding studies,37,87 high carbohydrate intake increases blood triglyceride concentration, reduces HDL cholesterol concentration, and increases blood pressure, especially in individuals with insulin resistance. These findings are of global significance because declining levels of physical activity and increasing adiposity will raise insulin resistance and exacerbate these metabolic responses to carbohydrate intake, and thus increase the risk of cardiovascular disease and diabetes.8