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Bread and the Mediterranean diet: A duet for the prevention of chronic diseases

Prof. Angel Gil

Department of Biochemistry and Molecular Biology II, Institute of Nutrition & Food Technology "José Mataix", Biomedical Research Center, University of Granada, CIBEROBN, Spain

Conflict of Interest Disclosure

I have no conflict of interest to report in relation to this presentation.

BioNIT

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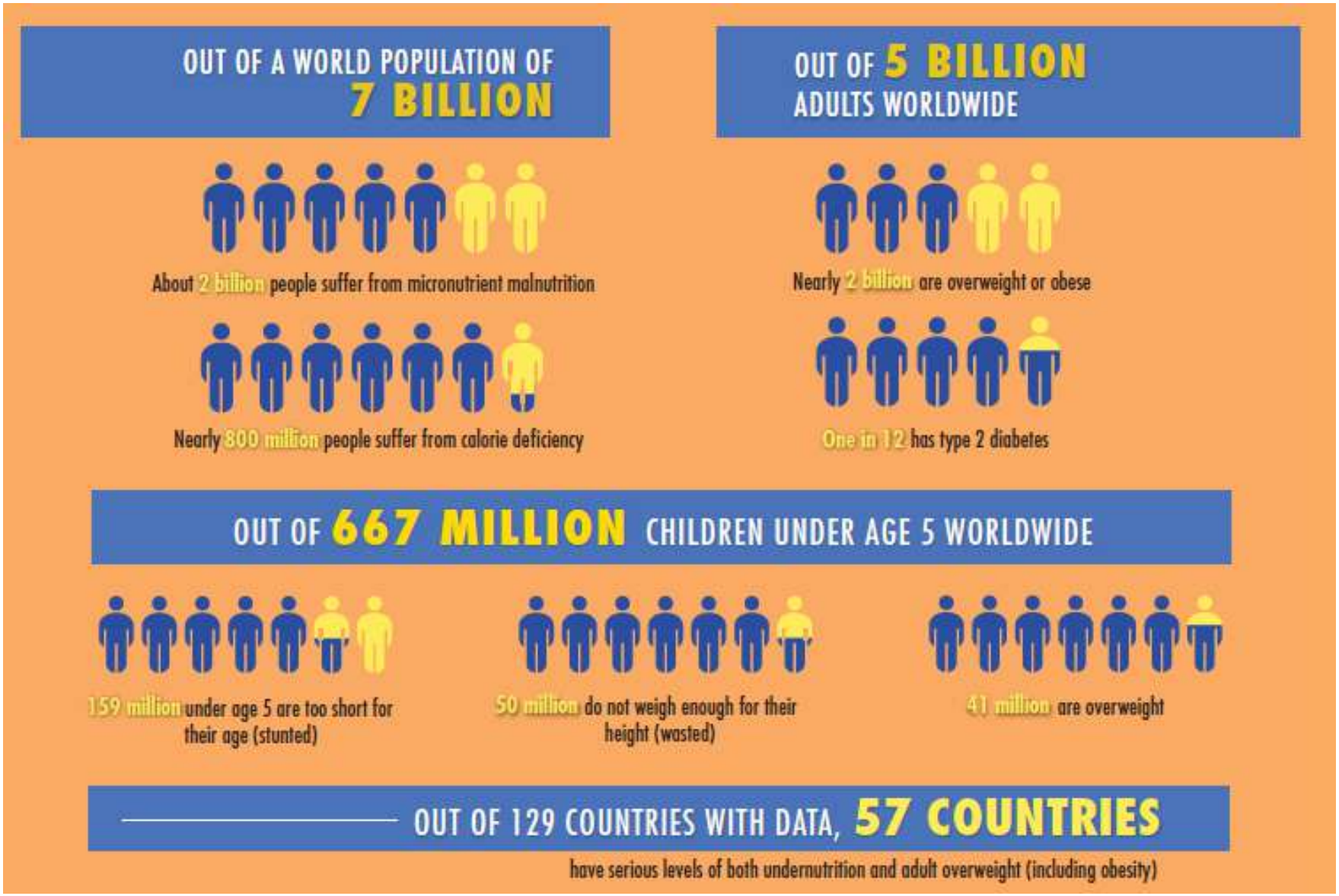
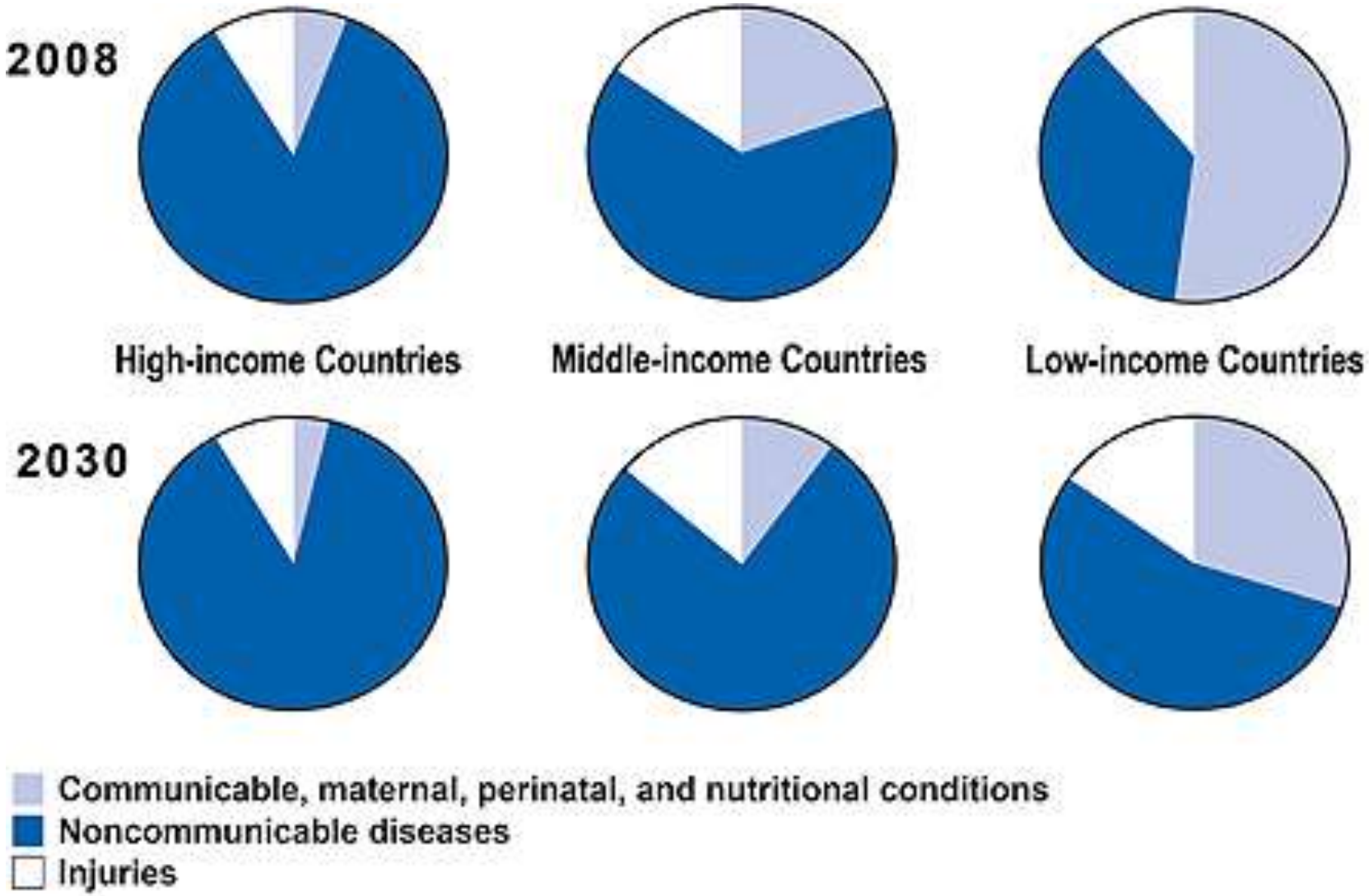
THE GLOBAL BURDEN OF MALNUTRITION 2016



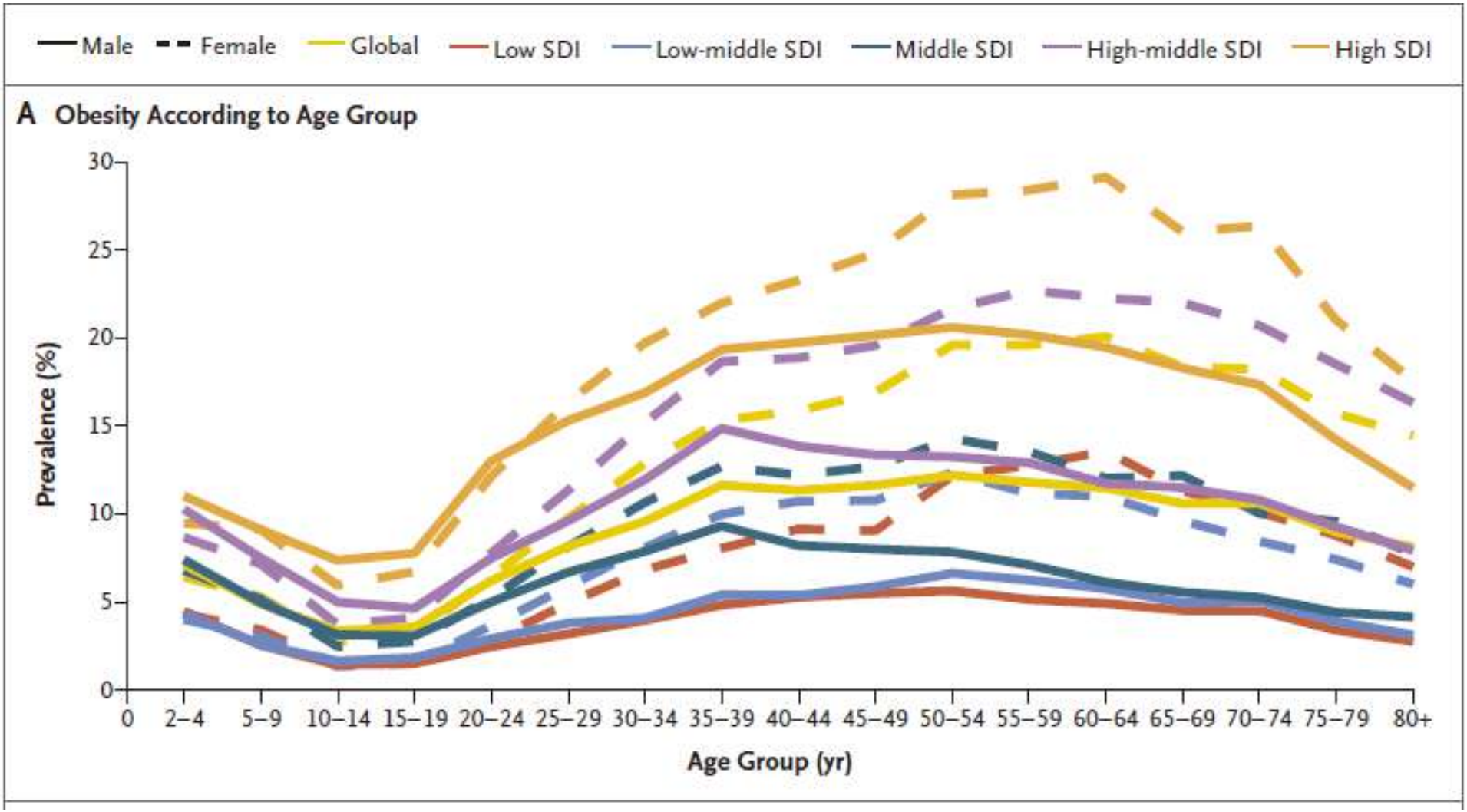
International Food Policy Research Institute. 2016. *Global Nutrition Report 2016: From Promise to Impact: Ending Malnutrition by 2030*. Washington, DC.

PREVALENCE OF NON-COMMUNICABLE CHORNIC DISEASES



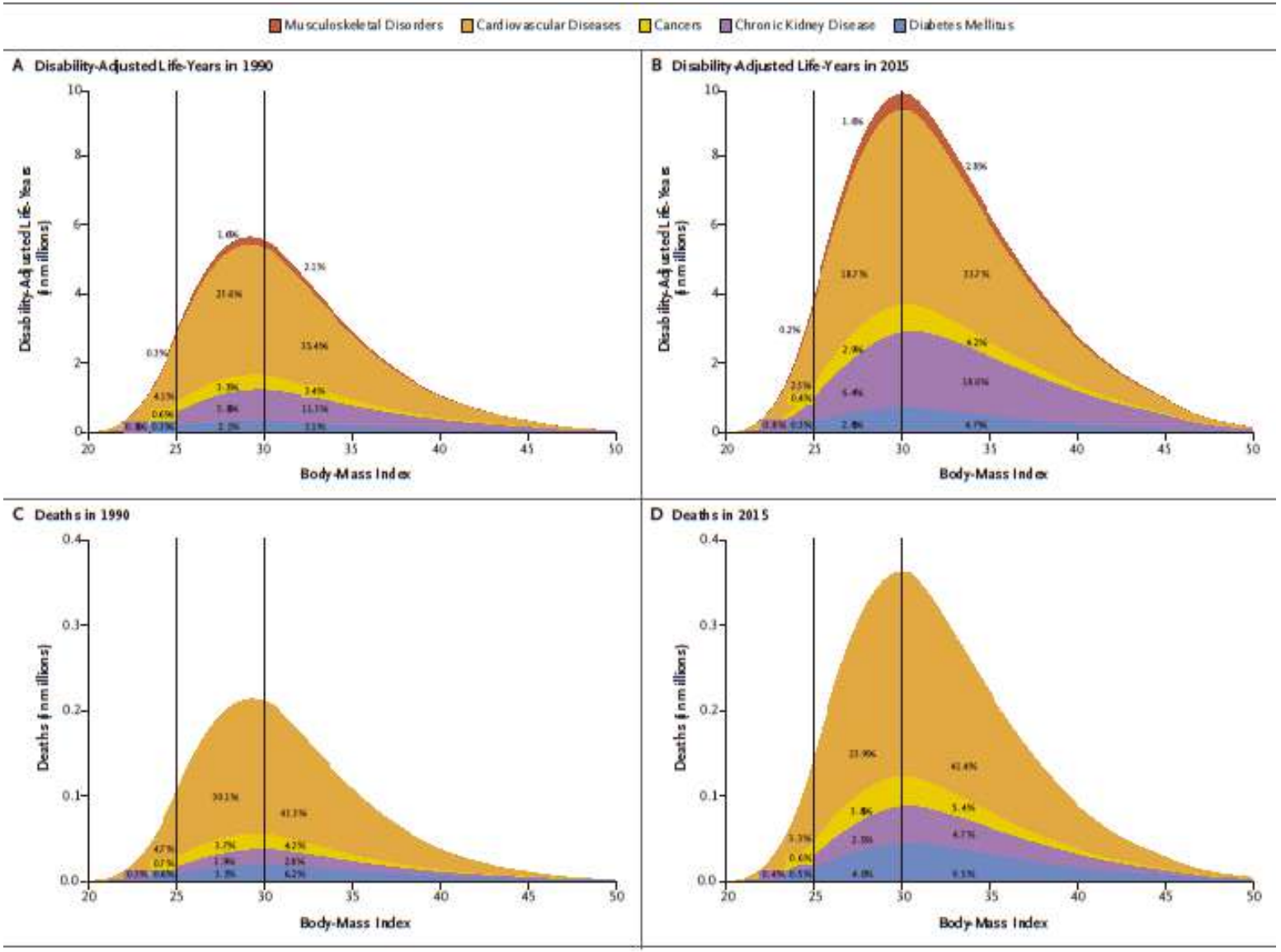
Fuente :WHO, 2015

GLOBAL PREVALENCE OF OVERWEIGHT AND OBESITY



The GBD 2015 Obesity Collaborators. N Engl J Med 2017;377:13-27.

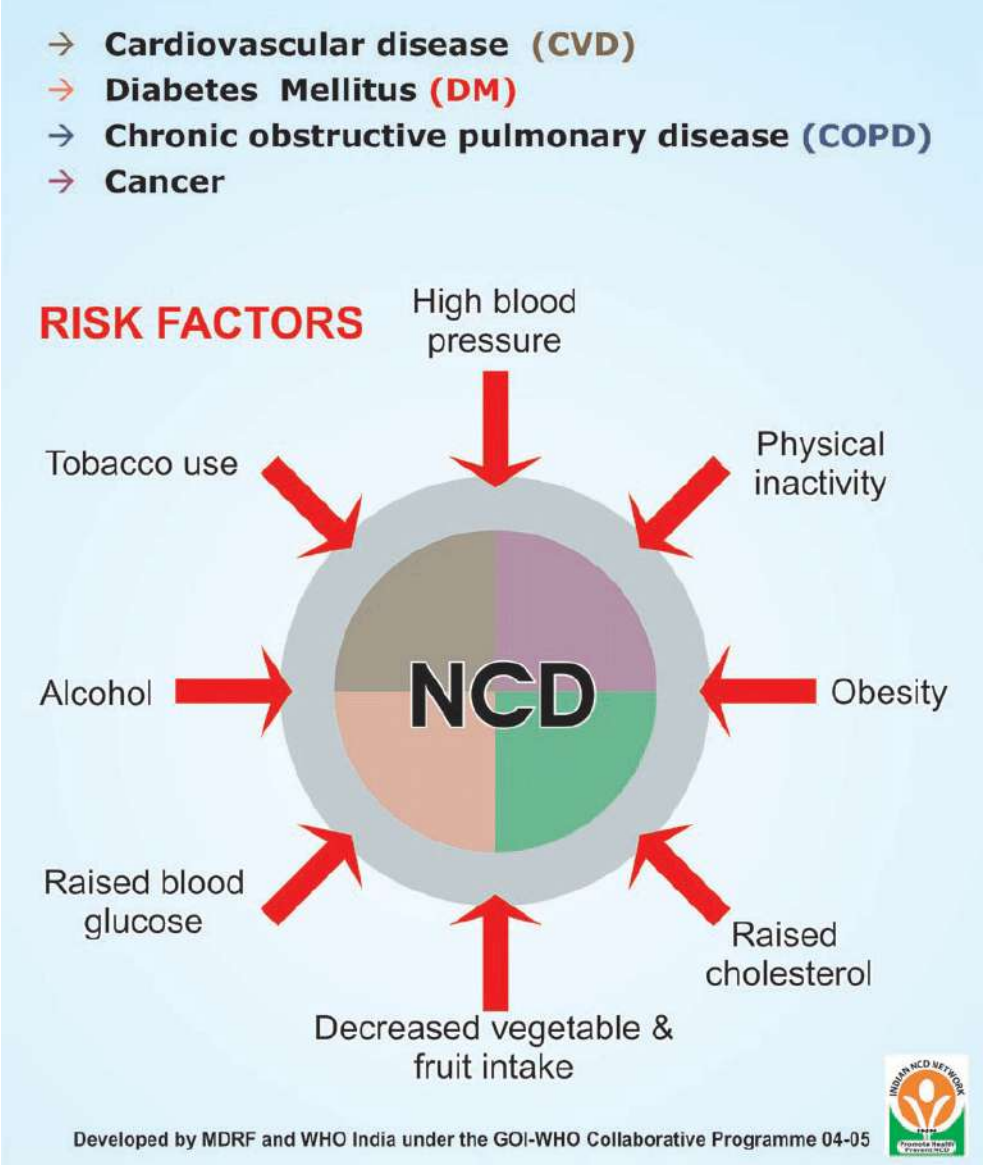
Global Disability-Adjusted Life-Years and Deaths Associated with a High Body-Mass Index (1990–2015).



The GBD 2015 Obesity Collaborators. N Engl J Med 2017;377:13-27.

RISK FACTORS OF NCCD

- Cardiovascular disease
- Diabetes
- Cancer
- Chronic respiratory disease
- Hypertension
- Dyslipidemia
- Obesity
- Metabolic syndrome
- Arthritis
- Osteopenia/osteoporosis
- Degenerative disc disease
- Depression
- Sarcopenia and frailty
- Cognitive impairment
- Cerebrovascular disease
- Neurodegenerative disease
- Rheumatoid arthritis



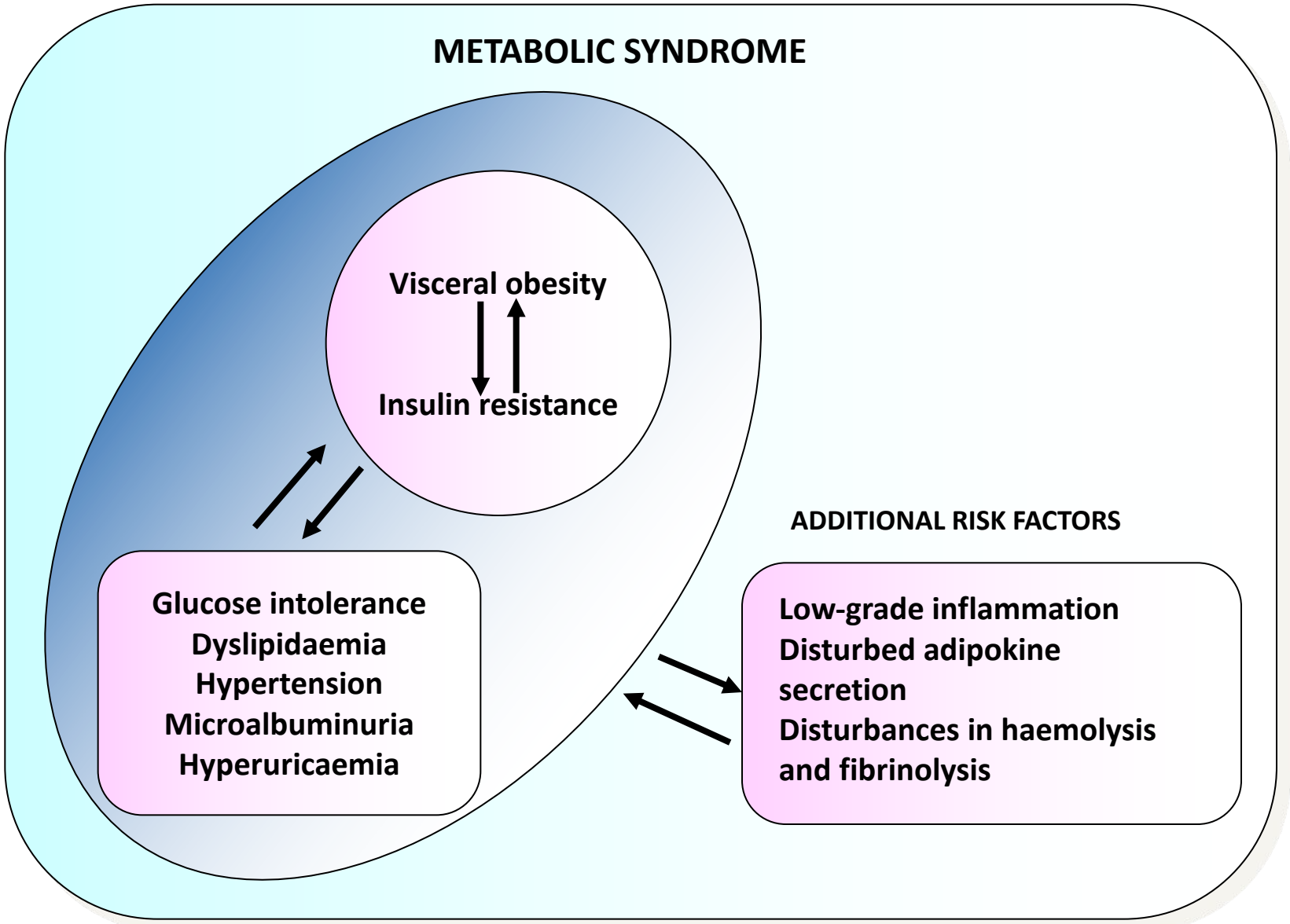
OBESITY: A FACTOR PREDISPONENT TO OTHER CHRONIC DISEASES

- Exces bodyweight and obesity is the 6th most important risk factor contributing to the overal burden of disease worlwide

- Obesity predisposes individuals to an increased risk of developing many diseases:

  Atherosclerosis
  Type 2 diabetes
  Non-alcoholic fatty liver disease
  Cancer
  Immune-mediated diseases (Asthma)
  Sleep apnea
  Bone fracture

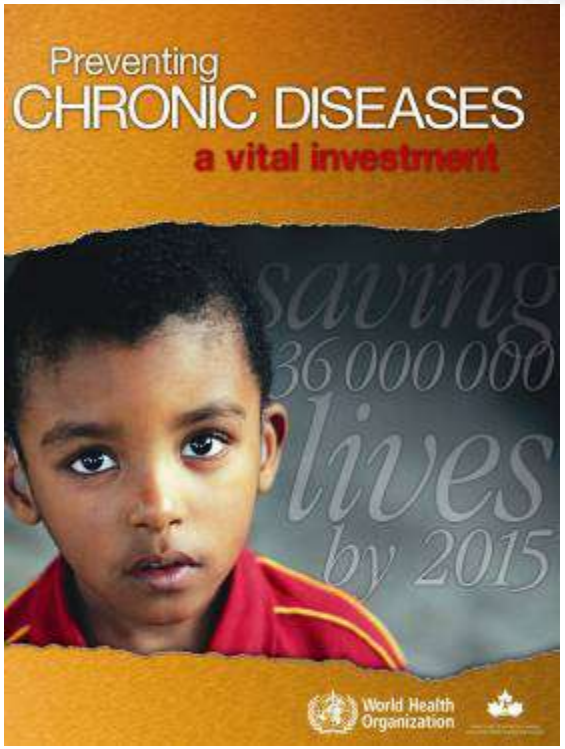
MAIN METABOLIC DISTURBANCES ASSOCIATED TO OBESITY



Preventing CHRONIC DISEASES

a vital investment

¡¡Mortality due to NCCD could be reduced by 50% by application of recent knowledge¡¡



World Health Organization

CEREAL CONSUMPTION AND PREVENTION OF CD: GENERAL ASPECTS

- The promotion of healthy lifestyles is one of the major goals of governments and international agencies all over the world.

- Wholegrain foods are considered as an important part of human diet due to their content of basic nutrients and health-enhancing or functional components. Wholegrain cereals are rich in nutrients and many phytochemical compounds, with recognised benefits for health, including dietary fibre, a number of phenolic compounds, lignans, vitamins and minerals and other bioactive components.

- The European, Canadian and USDA's dietary guidelines recommend approximately 3-8 servings of grains per day, of which at least one-half should come from wholegrain

- The beneficial health effects of grains are based on the positive relationship found between consumption of WG foods and reduced risk of chronic diseases.

CEREAL CONSUMPTION AND OBESITY

A long-standing belief held by the general public is that bread fattens. This encourages many people to restrict, or even eliminate, bread from their diet.

A systematic review including the results of a total of 38 epidemiological studies (22 cross-sectional, 11 prospective cohort, and 5 intervention) indicate that dietary patterns that include whole-grain bread do not positively influence weight gain and may be beneficial to ponderal status. With respect to dietary patterns that include refined bread, the majority of cross-sectional studies indicate beneficial effects, while most of the well designed cohort studies demonstrate a possible relationship with excess abdominal fat.

*Bautista-Castaño & Serra-Majem. Nutr Rev 2012; 2*18-233

Journal

Critical Reviews in Food Science and Nutrition ›

Volume 57, 2017 - Issue 14

Article

Modification of appetite by bread consumption: A systematic review of randomized controlled trials

Carolina Gonzalez-Anton, Reyes Artacho, Maria D. Ruiz-Lopez, Angel Gil & Maria D. Mesa

Pages 3035-3050 | Accepted author version posted online: 19 Oct 2015, Published online: 19 Oct 2015

The inclusion of appropriate ingredients such as fiber, proteins, legumes, seaweeds and acids into breads and the use of specific technologies may result in the development of healthier breads that increase satiety and satiation, which may aid in the control of weight gain and benefit postprandial glycemia.

CEREAL CONSUMPTION AND COMPONENTS OF METABOLIC SYNDROME HYPERTENSION (HTN)

- HTN remains an important public health problem.

- Whole grain breakfast cereal has been shown to decrease the risk of developing HTN

- In a cohort of 5,880 Spanish men and women, as compared to the lowest quintile of cereal fiber intake, the highest quintile was associated with a 40% decreased risk of HTN
Alonso, A., et al. Arch Med Res, 2006. 37: 778-86

CEREAL CONSUMPTION AND COMPONENTS OF METABOLIC SYNDROME HYPERTENSION (HTN)

- In a study of 28,926 female participants from theWomen's Health Study, multivariable adjusted RR's of HTN in subjects consuming <0.5, 0.5 to <1, 1 to <2, 2 to <4, and ≥4 wholegrain servings/day were 1.00 (reference), 0.96 (0.89-1.03), 0.95(0.88-1.02), 0.92 (0.85-0.99), 0.89 (0.82-0.97), respectively

Wang, L., et al., Am J Clin Nutr, 2007;.86: 472-9

- In the Health Professionals Follow-Up Study, the relative risk (RR) of HTN was 0.81 (95% CI: 0.75-0.87) in the highest compared with the lowest quintile of whole grain consumption (from various sources such as breakfast ereal, dark bread, cooked brown rice, and pasta)

Flint, A.J., et al., Am J Clin Nutr, 2009; 90: 493-8

In a cohort of 13,368 US male physicians, it has been shown a dose dependent inverse association between consumption of whole grain breakfast cereal and the risk of developing HTN, after adjusting for age, smoking, BMI, alcohol consumption, fruit and vegetable consumption, physical activity, and history of DM

Kochar et al. Clin Nutr 2012; 31; 89-92.

CEREAL CONSUMPTION AND COMPONENTS OF METABOLIC SYNDROME CHOLESTEROL

In a subsample of the Study Tracking Health Professionals and the Nurses' Health Study II, a broad range of biomarkers related to the metabolic syndrome was measured. Greater consumption of wholegrain cereal was associated with lower homocysteine and total cholesterol as well a s low levels of inflammatory biomarkers

Jensen MK et al . Am J Clin Nutr 2006; 83, 275–283.

CEREAL CONSUMPTION AND CARDIOVASCULAR DISEASES

There is ample epidemiological and clinical evidence that relates the consumption of wholegrain cereals with areduced risk of coronary disease.

Subjects who ingest three or more rations of foods per day based on integral cereals have a 20–30% lower risk than subjects who ingest low quantities of cereals, and this level of protection is not observed with the ingestion of refined cereals, these being even higher than with the intake of fruits and vegetables.

Gil A, et al. Public Health Nutrition, 2011; 14: 2316-22

CEREAL CONSUMPTION AND CARDIOVASCULAR DISEASES

A significant inverse trend between the intake of wholegrain cereal and mortality by CVD, independently of demography, lifestyle or dietary factors. In addition, glucose while fasting and the BMI diminished as the quartiles increased in the category of wholegrain consumption has been found

Sahyoun NR et al. Am J Clin Nutr 2006; 83, 124–131.

CEREAL CONSUMPTION AND HEART FAILURE

- Heart failure is the leading cause of hospitalization in the elderly in Western countries.

- In the Physicians' Health Study cohort, for average weekly whole grain cereal consumption of 0 servings, 1 or fewer, 2 to 6, and 7 or more decreases the hazard ratios of HF form 14 to 28%, after adjusting for age, smoking, alcohol consumption, vegetable consumption, use of multivitamins, exercise, and history of atrial fibrillation, valvular heart disease, and left ventricular hypertrophy.

CEREAL CONSUMPTION AND TYPE 2 DIABETES MELLITUS (DM)

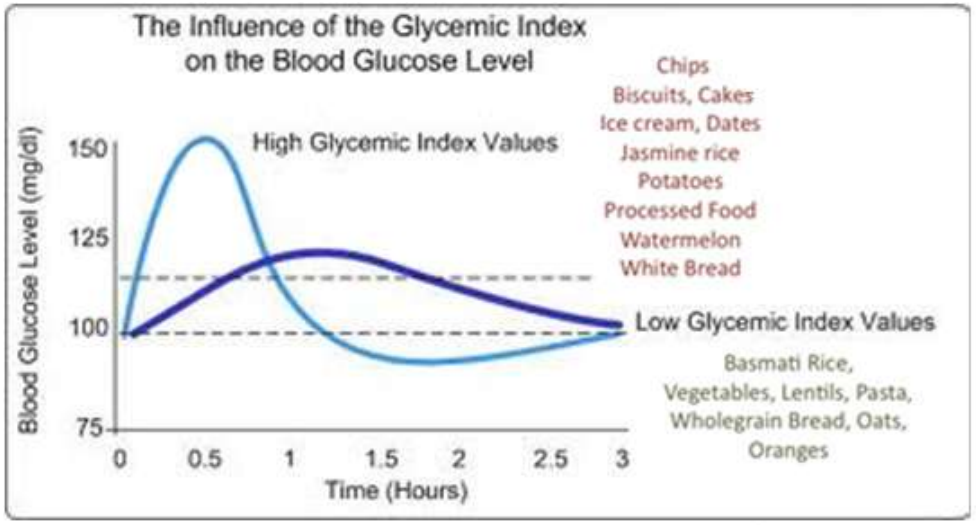
- The beneficial effect of whole grain consumption on DM has been shown in multiple other studies ranging from cross sectional studies and in randomized controlled trials.
McKeown, N.M., et al Am J Clin Nutr, 2002; 76: 390-8.
Jang, Y., et al., Arterioscler Thromb Vasc Biol, 2001;21: 2065-71.

- In a randomized trial of 76 male patients with history of coronary artery disease, as compared to the control group, consumption of whole grain meal daily for 16 weeks decreased serum glucose concentration by 24%, and insulin levels by 14%.
Jang, Y., et al., Arterioscler Thromb Vasc Biol, 2001;21: 2065-71.

In a study of 21,152 male participants of the Physicians' Health Study I (PHS) cereal consumption decreased the risk of diabetes de 11 a45 % ((lower to higher), after adjusting for age, cigarette smoking, BMI, physical activity, vegetable consumption, and alcohol intake
Kochar et al. Obesity 2007; 15: 3039-44.

GLYCAEMIC LOAD (GL)

The **glycaemic index (GI)** is a measure of how much a food raises blood sugar levels when compared against the effects of pure glucose.

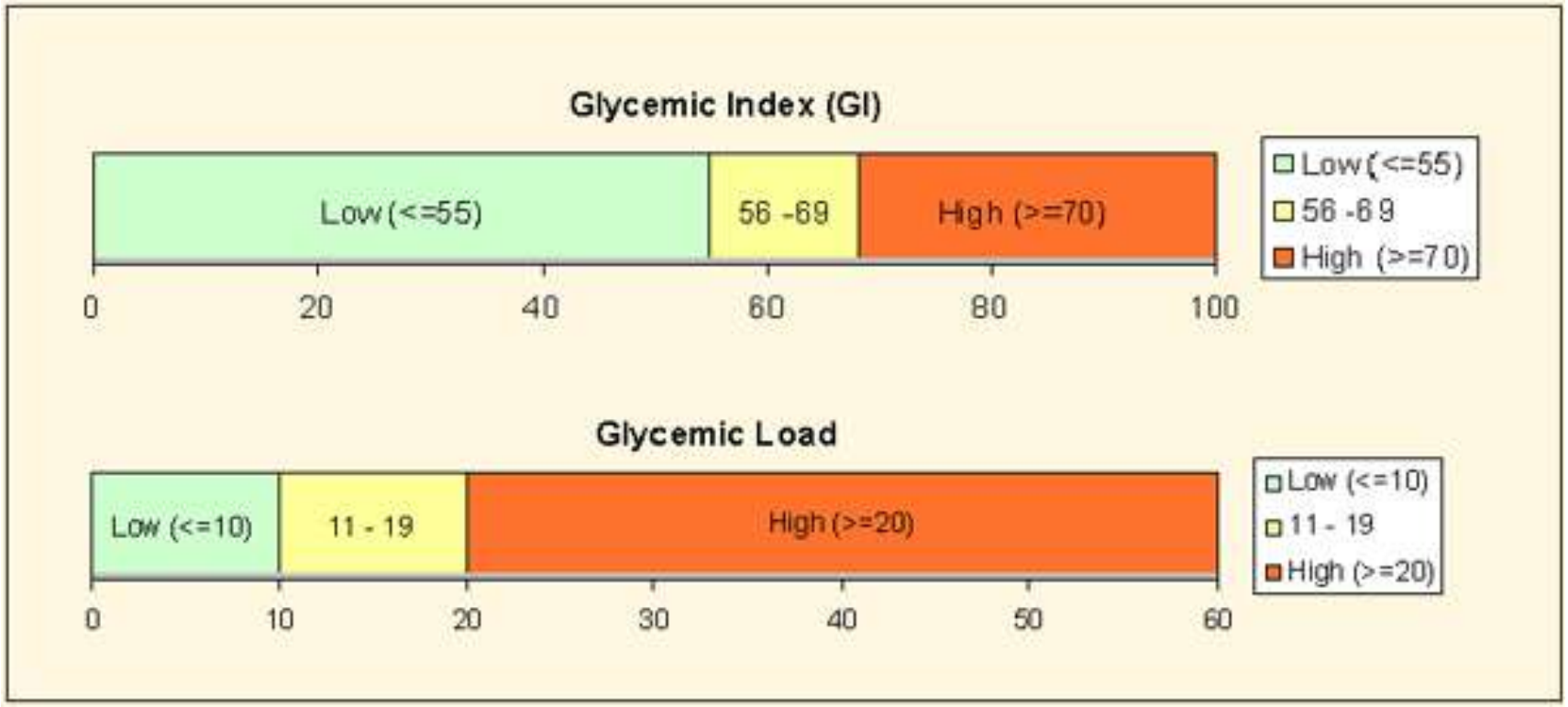


The amount of carbohydrate in the reference and test food must be the same.

The **glycaemic load (GL)** is what you get by multiplying the glycaemic index by the number of available carbohydrates consumed and then dividing by 100.

GL accounts for how much carbohydrate is in the food and how much each gram of carbohydrate in the food raises blood glucose levels.

GLYCAEMIC INDEX
&
GLYCAEMIC LOAD



GLYCAEMIC INDEX OF SOME BREADS

Low GI (≤ 55)	**Medium GI** (56-69)	**High GI** (≥ 70)
Soya and Linseed Wholegrain pumpernickel Heavy mixed grain Whole Wheat Sourdough rye Sourdough wheat	Croissant Hamburger bun Pita, white Wholemeal rye	White bread Bagels French baguette

Nutrients **2015**, *7*, 4033-4053; doi:10.3390/nu7064033

OPEN ACCESS

nutrients

ISSN 2072-6643

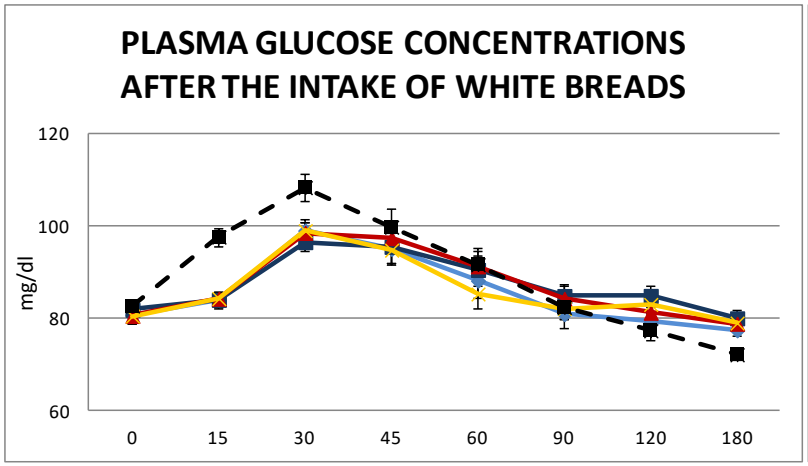
www.mdpi.com/journal/nutrients

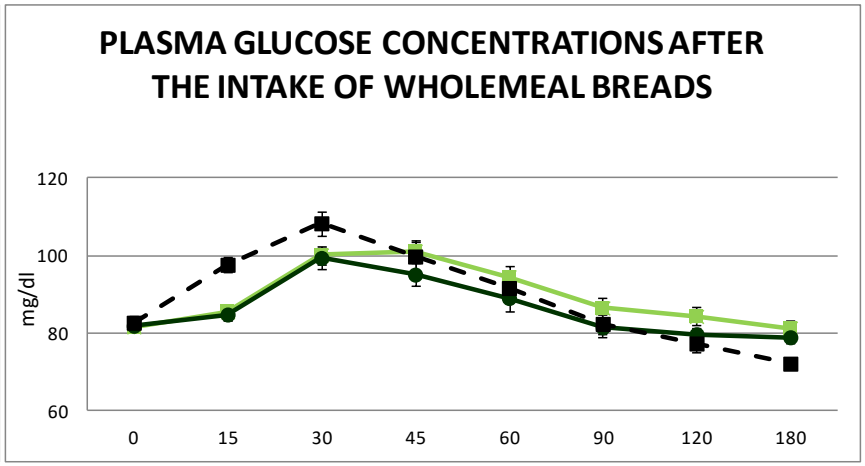
Article

Glycemic Responses, Appetite Ratings and Gastrointestinal Hormone Responses of Most Common Breads Consumed in Spain. A Randomized Control Trial in Healthy Humans

Carolina Gonzalez-Anton [1], Maria C. Rico [1], Estefania Sanchez-Rodriguez [1], Maria D. Ruiz-Lopez [2], Angel Gil [1,*] and Maria D. Mesa [1]

PLASMA GLUCOSE CONCENTRATIONS AFTER THE INTAKE OF SIX DIFFERENT TYPES OF SPANISH BREADS



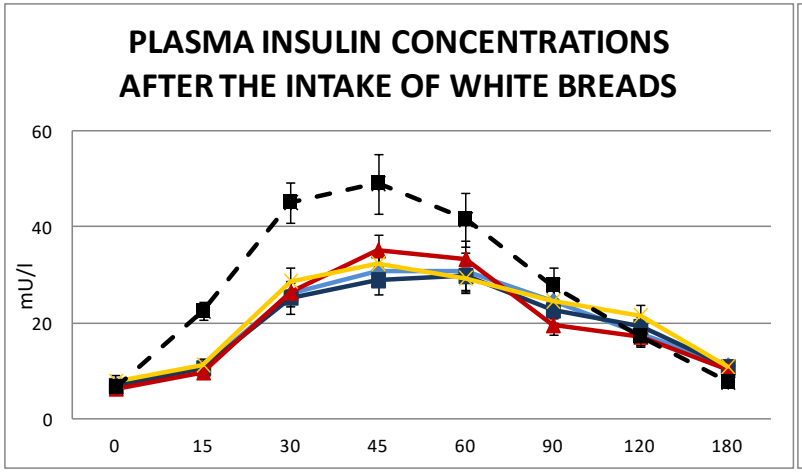


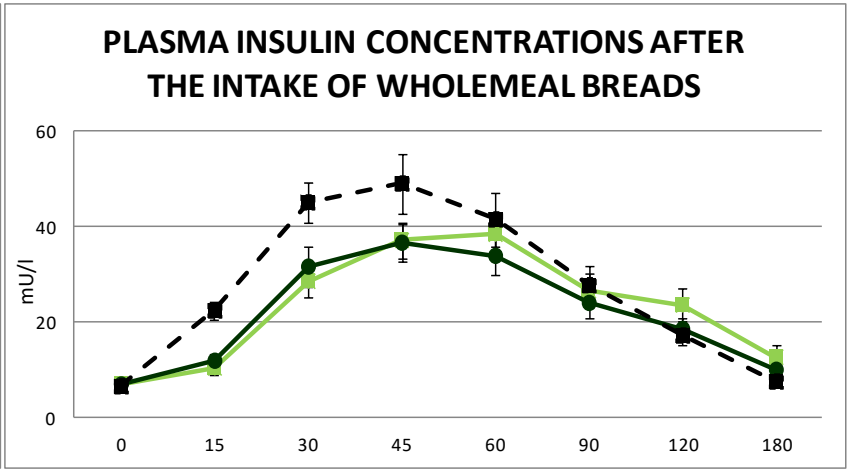
***P* values for Glucose plasma concentrations**

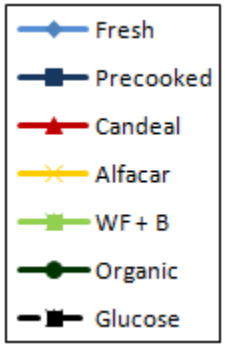
		0 min	15 min	30 min	45 min	60 min	90 min	120 min	180 min
Glucose *vs*	**Fresh**	0,970	**0,000**	**0,006**	0,897	0,985	1,000	1,000	0,074
	Precooked	1,000	**0,000**	**0,000**	0,959	1,000	1,000	**0,035**	**0,000**
	Candeal	0,920	**0,000**	**0,003**	1,000	1,000	1,000	0,893	**0,005**
	Alfacar	0,910	**0,000**	**0,006**	0,848	0,275	1,000	0,301	**0,004**
	WF + B	1,000	**0,000**	**0,029**	1,000	0,998	0,941	0,073	**0,000**
	Organic	1,000	**0,000**	**0,011**	0,908	1,000	1,000	1,000	**0,004**
Alfacar *vs*	**WF + B**	1,000	1,000	1,000	0,454	**0,010**	0,902	1,000	0,990

WF+B: White flour added with bran wholemeal bread

PLASMA INSULIN CONCENTRATIONS AFTER THE INTAKE OF SIX DIFFERENT TYPES OF SPANISH BREADS







***P* values for Insulin plasma concentrations**

		0 min	15 min	30 min	45 min	60 min	90 min	120 min	180 min
Glucose *vs*	**Fresh**	1,000	**0,000**	**0,000**	**0,000**	**0,013**	0,997	1,000	0,259
	Precooked	1,000	**0,000**	**0,000**	**0,000**	**0,004**	0,760	0,999	0,435
	Candeal	1,000	**0,000**	**0,000**	**0,002**	0,152	0,075	1,000	0,778
	Alfacar	0,967	**0,000**	**0,000**	**0,000**	**0,002**	0,997	0,298	0,367
	WF + B	1,000	**0,000**	**0,000**	**0,015**	1,000	1,000	**0,010**	**0,008**
	Organic	1,000	**0,000**	**0,000**	**0,010**	0,249	0,987	1,000	0,818
WF + B *vs*	**Fresh**	1,000	1,000	1,000	0,795	0,259	1,000	**0,042**	0,997
	Candeal	1,000	1,000	1,000	1,000	0,882	0,227	**0,008**	0,782

WF+B: White flour added with bran wholemeal bread

GLYCAEMIC INDEX, GLYCAEMIC LOAD AND INSULINEMIC INDEX AFTER THE INTAKE OF SIX DIFFERENT TYPES OF SPANISH BREADS

Glycaemic Index, Glycaemic Load and Insulinemic Index of six different types of Spanish Breads (n=22)

	WHITE BREADS				WHOLEMEALS	
	Fresh	**Precooked**	**Candeal**	**Alfacar**	**WF+B**	**Organic**
	Mean±SEM	Mean ± SEM	Mean±SEM	Mean±SEM	Mean±SEM	Mean±SEM
GI (%)	85±12	102 ± 16	108±17	85±12	118±15	73±8
GL (%)	18±3^{ab}	20 ± 3^{b}	23±4^{b}	18±2^{ab}	24±3^{b}	11±1^{a}
InI (%)	74±7	76 ± 9	77±6	78±4	93±7	79±5

GI: Glycaemic index; *GL*: Glycaemic load; *II*: Insulinemic index; *WF+B*: White flour added with bran bread. Different superscript letters within the same row indicates significant differences between breads (*P*<0,05).

CEREAL CONSUMPTION AND CANCER

A meta-analysis on the consumption of WG cereals and cancer that analysed all the studies conducted up to 1998 indicated protection against the risk of colorectal cancer and polyps, other cancers of the digestive tract, cancers related to hormones and pancreatic cancer.

Cohort studies have shown a lower risk for specific cancers, such as colorectal in women stomach, mouth/throat and the upper digestive tract and endometrium.

A review of forty studies on gastrointestinal cancer has found a reduction in cancer risk from 21% to 43% in subjects with high consumption of wholegrain cereals compared to those with low consumption.

Gil A, et al. Public Health Nutrition, 2011; 14: 2316-22

CEREAL CONSUMPTION AND CANCER

In more recent cohort studies, the intake of WG cereals has been associated with a moderate reduction in colorectal cancer risk.

A recent meta-analysis has shown that the intake of products having a low GI and GL, including products based on cereals with a high fibre content, was associated with a lower risk of colorectal, pancreatic, endometrium and breast cancer.

However, a recent study published jointly between the World Cancer Research Fund and the Institute for Cancer Research on the relative risk of different types of cancer in relation to different lifestyles found no association between the specific consumption of cereals and colorectal cancer.

Gil A, et al. Public Health Nutrition, 2011; 14: 2316-22

BIOLOGICAL MECHANISM OF THE PROTECTIVE EFFECT OF WHOLE GRAIN CEREALS

- Along with fiber, whole grain cereals have diverse nutrients such as phytosterols, tocotrienols, unsaturated fatty acids, sphingolipids, phytin, lignans, bioactive compounds with antioxidant capacity (carotens, tocopherols, selenium, etc.)

- Fermentation of the undigested carbohydrates from whole grain cereal yields short chain fatty acids in the colon, which may lower serum cholesterol.

- Soluble fiber content of whole grain cereals may improve glycemic control. In fact, whole grain meal causes lower plasma glycemic and insulinemic response as compared to fine flour meal. Similarly, low glycemic response to wholegrain breads have been observed

BIOLOGICAL MECHANISM OF THE PROTECTIVE EFFECT OF WHOLE GRAIN CEREALS

- Oxidative damage has been suggested as possible mechanism for various chronic diseases, such as destruction of endocrine pancreatic cells leading to DM.

- Whole grain products have antioxidant capacity comparable to fruits and vegetables

- Subjective satiety was greater for whole grain meal as compared to fine flour meal.

- Certain minerals such as potassium found in whole grains have been showed to decrease blood pressure.

- Phytosterol induced improvement in serum lipid parameters, as well as body weight may also explain the beneficial effects of whole grains.

BIOLOGICAL MECHANISM OF THE PROTECTIVE EFFECT OF WHOLE GRAIN CEREALS

- The components of wholegrain cereals, including fibre, resistant starch and oligosaccharides, play a fundamental role in the maintenance of intestinal homeostasis.

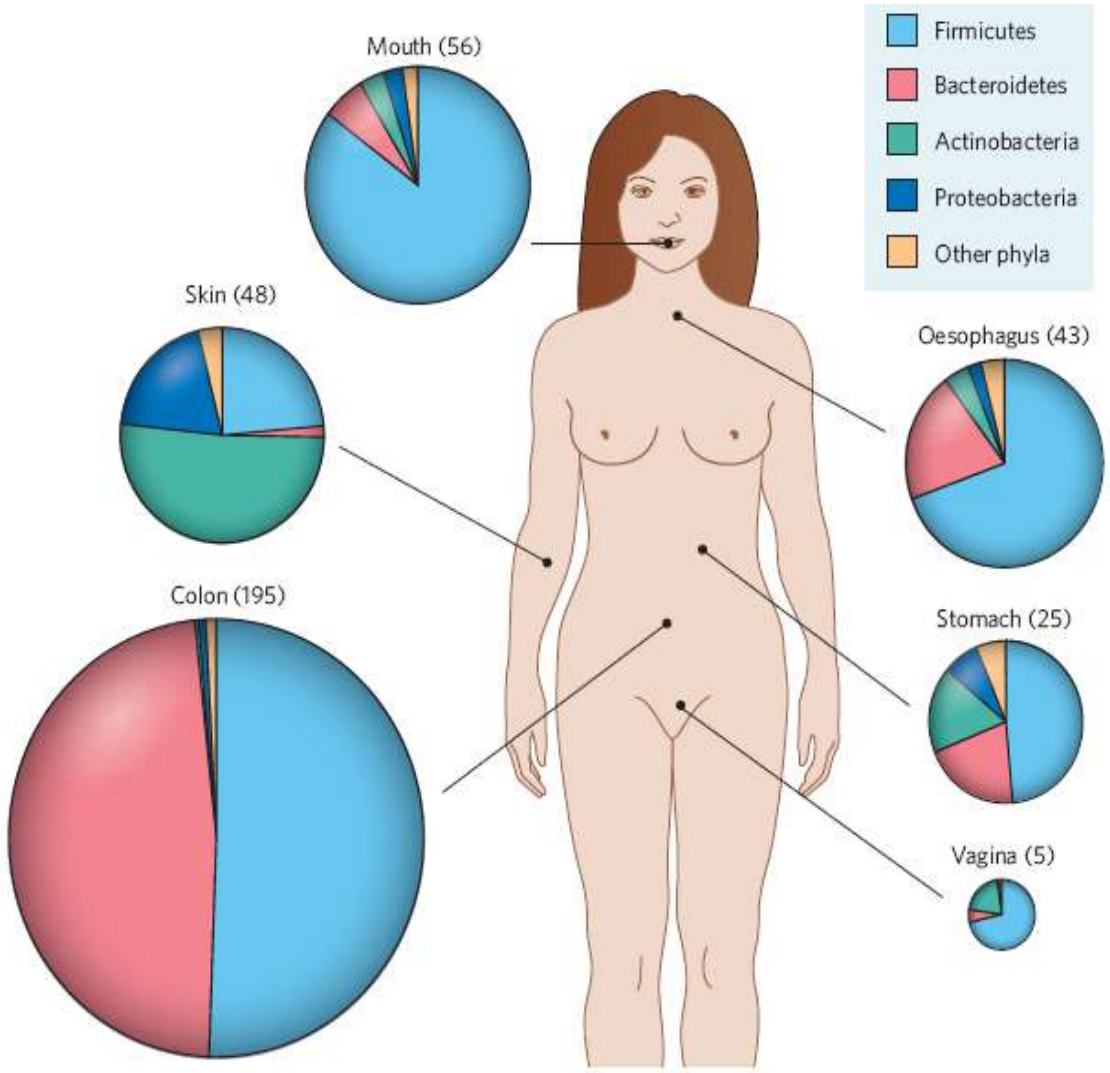
- Several studies have suggested that the dietary fibre from grains and whole cereals augments the weight of the stool and absorb water, and the partial fermentation of the fibre in the colon as well as of the oligosaccharides promotes the growth of beneficial bacteria in the faeces

HUMAN MICROBIOTA
LIVING WITH TRILLIONS (10^{12}) OF MICROORGANIMS

The complex community of microorganisms living in skin and mucosal surfaces in humans (10^{10}-10^{11})

http://www.nature.com/nature/focus/humanmicrobiota/

SITE-SPECIFIC DISTRIBUTIONS OF BACTERIAL PHYLA IN HEALTHY HUMANS



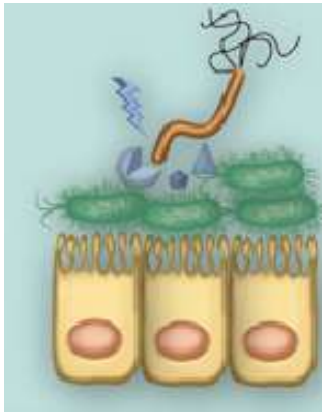
Les Dethlefsen et al. (2007) Nature 449, 811-818

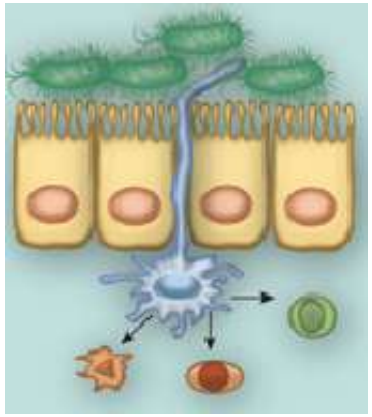
THE HUMAN GUT MICROBIOME

HOST
Genetics
Sex
Age
Immune systemo
Intestinal motility

DIET
Non-digestible CHO
Fat
Proteins
Pro biotics

TREATMENT
Antibiotics
Gastric *Bypass*





CHANGES IN MICROBIAL METABOLISM
Saccharolytic activity
Producción de sales biliares

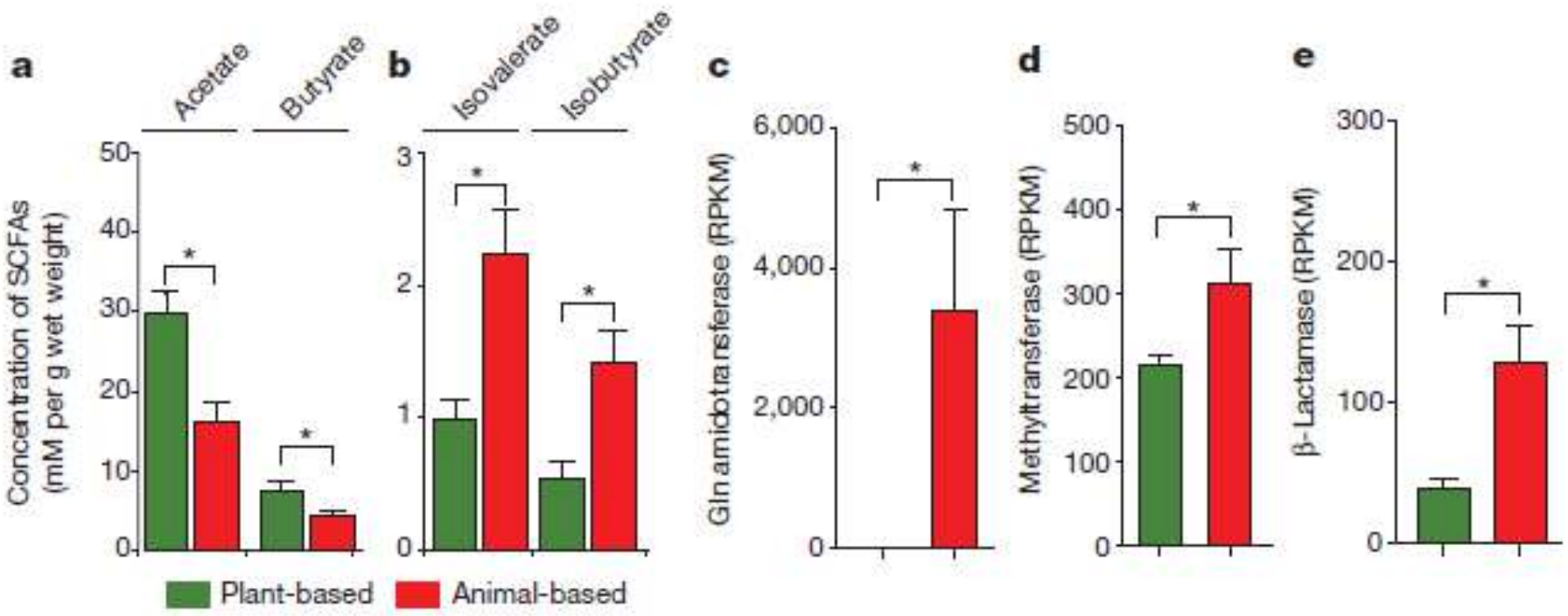
CHANGES IN COMPOSITION (PHYLOGENY))
Phyla: *Bacteroidetes* y *Firmicutes*
Class: Mollicutes
Genus/Species:: Bifidobacterium/Lactobacillus

PHENOTYPIC CHANGES
Saciety
Energy efficiency
Fat mass
Glucose tolerance
Insulin sensitivity
Inflammation
Esteatosis

Adapted from Gil A. Tratado de Nutrición, Tomo II, 3ª Ed, Médica Panamericana, Madrid, 2017

MICROBIOTA AND NUTRITION

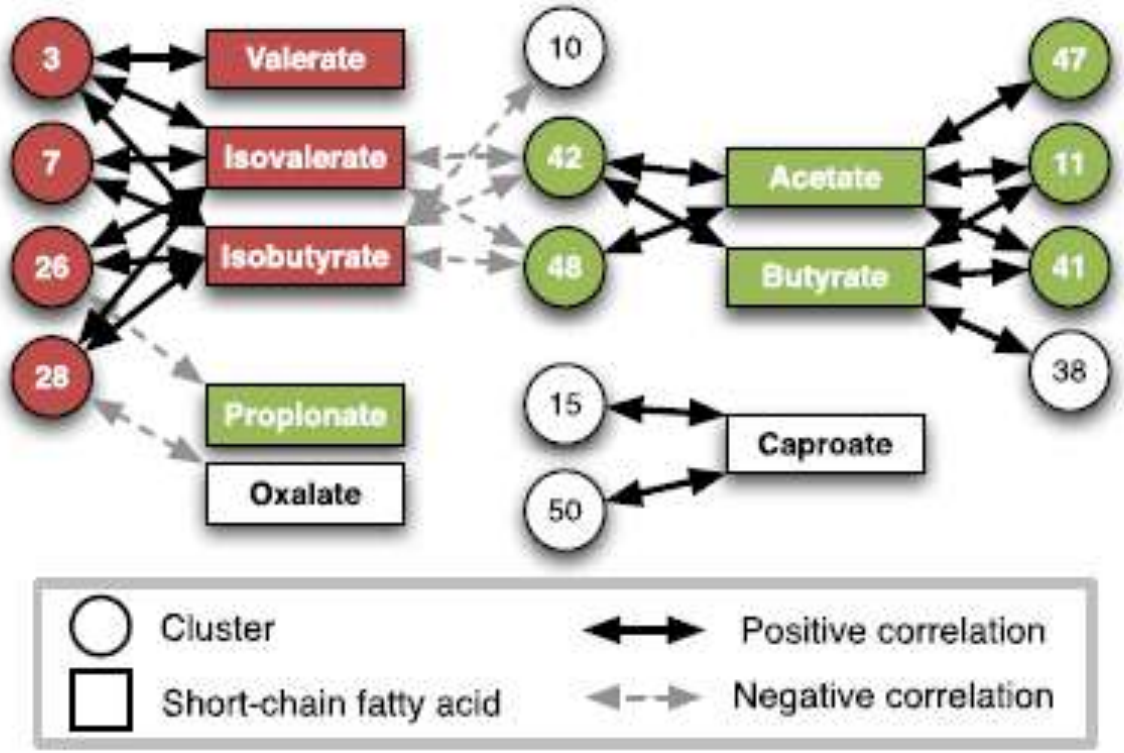
Diet alters microbiome activity and gene expression



David et al. Nature 2014; 5 0 5: 5 5 9-566

MICROBIOTA AND NUTRITION

Diet rapidly and reproducibly alters the human gut microbiome



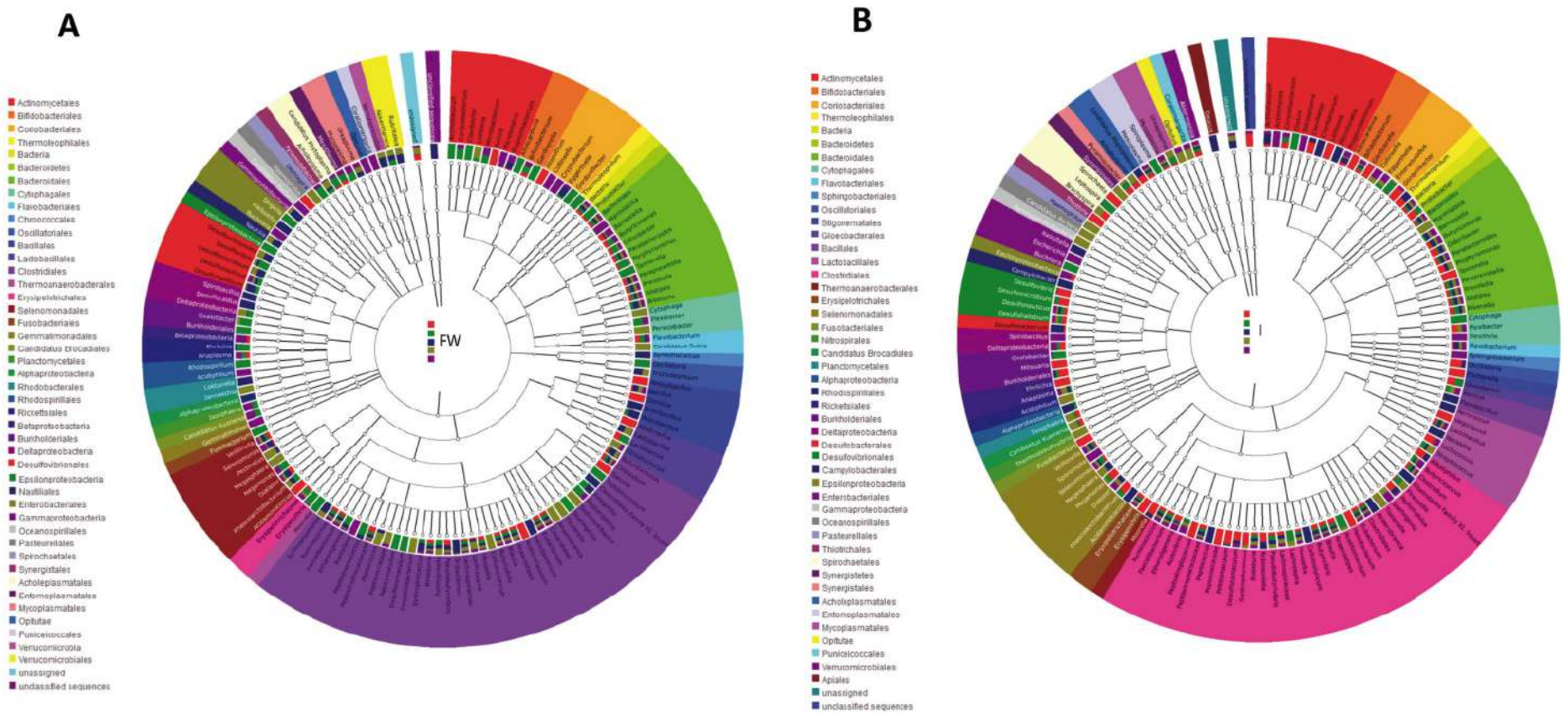
Cluster membership

3	7	26	28	*Bile / Putrefactive*
				Bilophila
				Alistipes
				Bacteroides

11	41	47	42	48	*Saccharolytic*
					Roseburia
					E. rectale
					F. prausnitzii
					Bifidobacterium

David et al. Nature 2014; 5 0 5: 5 5 9-566

EFFECT S OF *Lactobacillus rhamnosus* CNCM I-4036 ON INTESTINAL MICROBIOTA IN HEALTHY ADULTS



Plaza-Diaz et al. Nutrients 2015, 7, 3999-4015; doi:10.3390/nu7063999

International Journal of *Molecular Sciences*

Int. J. Mol. Sci. **2016**, *17*, 928; doi:10.3390/ijms17060928

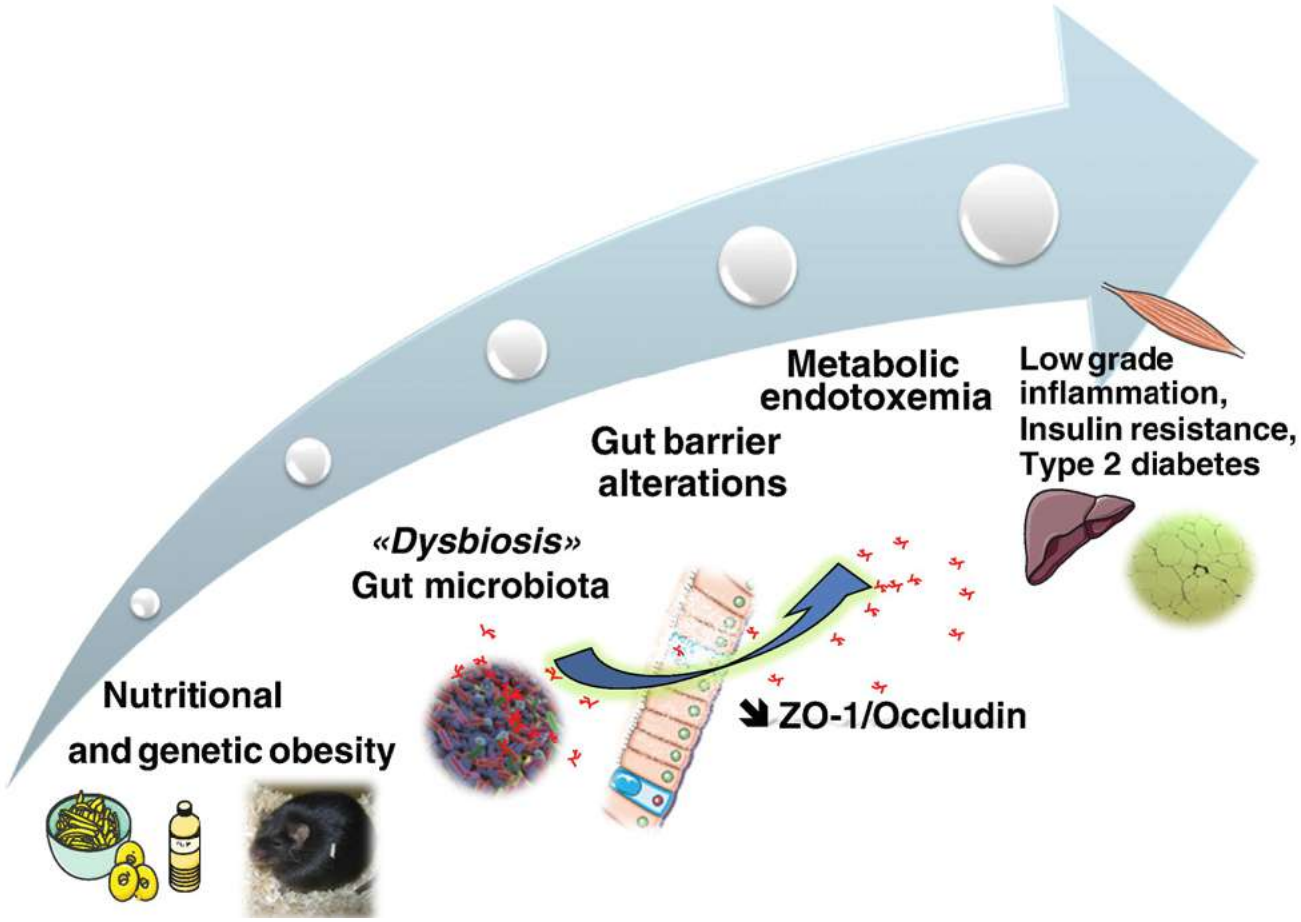
MDPI

Review

Effects of Probiotics and Synbiotics on Obesity, Insulin Resistance Syndrome, Type 2 Diabetes and Non-Alcoholic Fatty Liver Disease: A Review of Human Clinical Trials

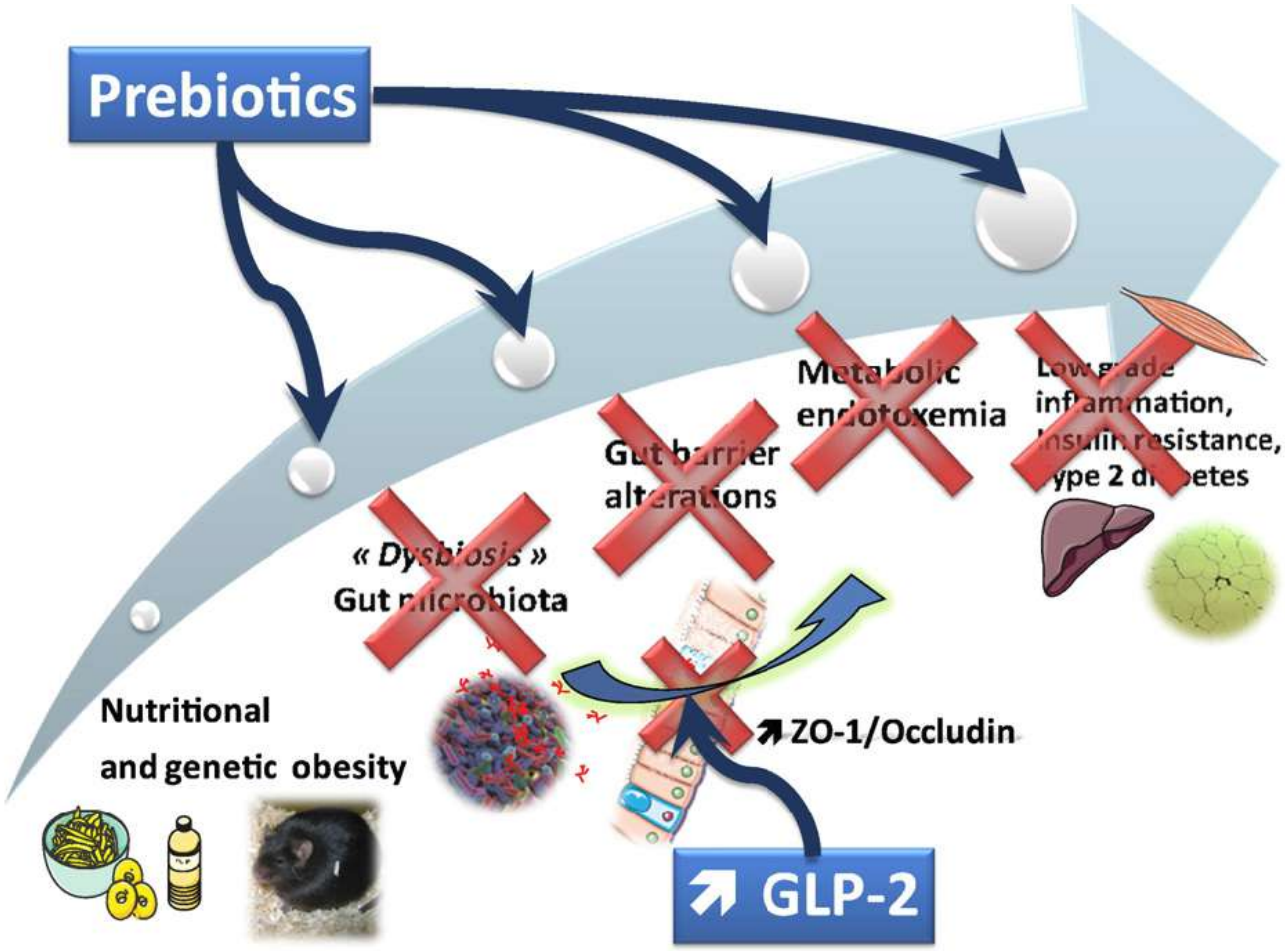
Maria Jose Sáez-Lara [1,2], Candido Robles-Sanchez [2,3], Francisco Javier Ruiz-Ojeda [2,3,4], Julio Plaza-Diaz [2,3,4] and Angel Gil [2,3,4,5,*]

INTESTINAL MICROBIOTA AND DEVELOPMENT OF CD



Cani PD, Delzenne NM. Pharmacology & Therapeutics 2011; 130: 202–212

CHANGES INDUCED BY UNDIGESTIBLE CARBOHYDRATES ON INTESTINAL MICROBIOTA AND CD



Cani PD, Delzenne NM. Pharmacology & Therapeutics 2011; 130: 202–212

CONCLUSIONS

There is sufficient epidemiological evidence, as well as biological explanation to suggest inverse association between whole grain cereal products consumption and incidence of major chronic diseases such as obesity, diabetes mellitus, cardiovascular diseases --mainly heart failure, and cancer

CONCLUSIONS

- Several studies show consistently that subjects who ingest three or more portions of foods per day based on wholegrain cereals have a 20–30% lower risk of CVD than subjects who ingest low quantities of cereals. This level of protection is not observed with the ingestion of refined cereals, these being even higher than with the intake of fruit and vegetables.

- High intake of whole grain cereals and their products is associated with a 20–30% reduction in the risk of type 2 diabetes.

- Protection against the risk of colorectal cancer and polyps, other cancers of the digestive tract, cancers related to hormones and pancreatic cancer, has been associated with the regular consumption of wholegrain cereals and derived products.

CONCLUSIONS

- Typical Spanish breads differing mainly in their manufacturing process show different GI, the lowest being the organic whole meal made (72%) , followed by Alfacar and Fresh breads (85%).

- All breads had significantly lower GL compared with glucose. The lowest GL were found for whole meal made (11) , followed by Alfacar and Fresh breads (18), compared with precooked (20), candeal (23) and WF+B (24).

- The InI of breads ranged 74-79% excepting the WF+B

MANY THANKS