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Centre universitaire de médecine générale
et santé publique · Lausanne

Precision nutrition and public health
EPFL, April 3nd, 2025

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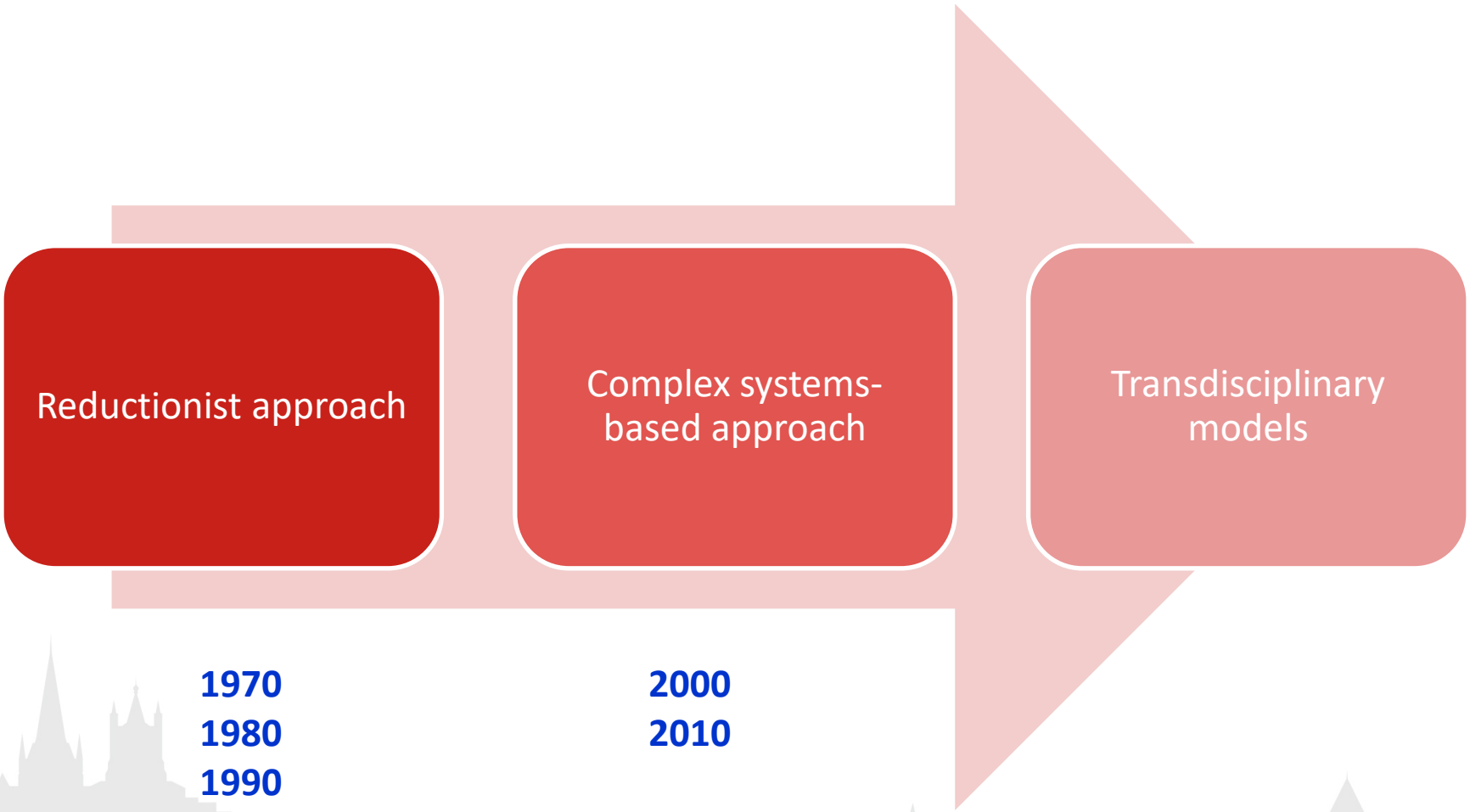
UNIL | Université de Lausanne

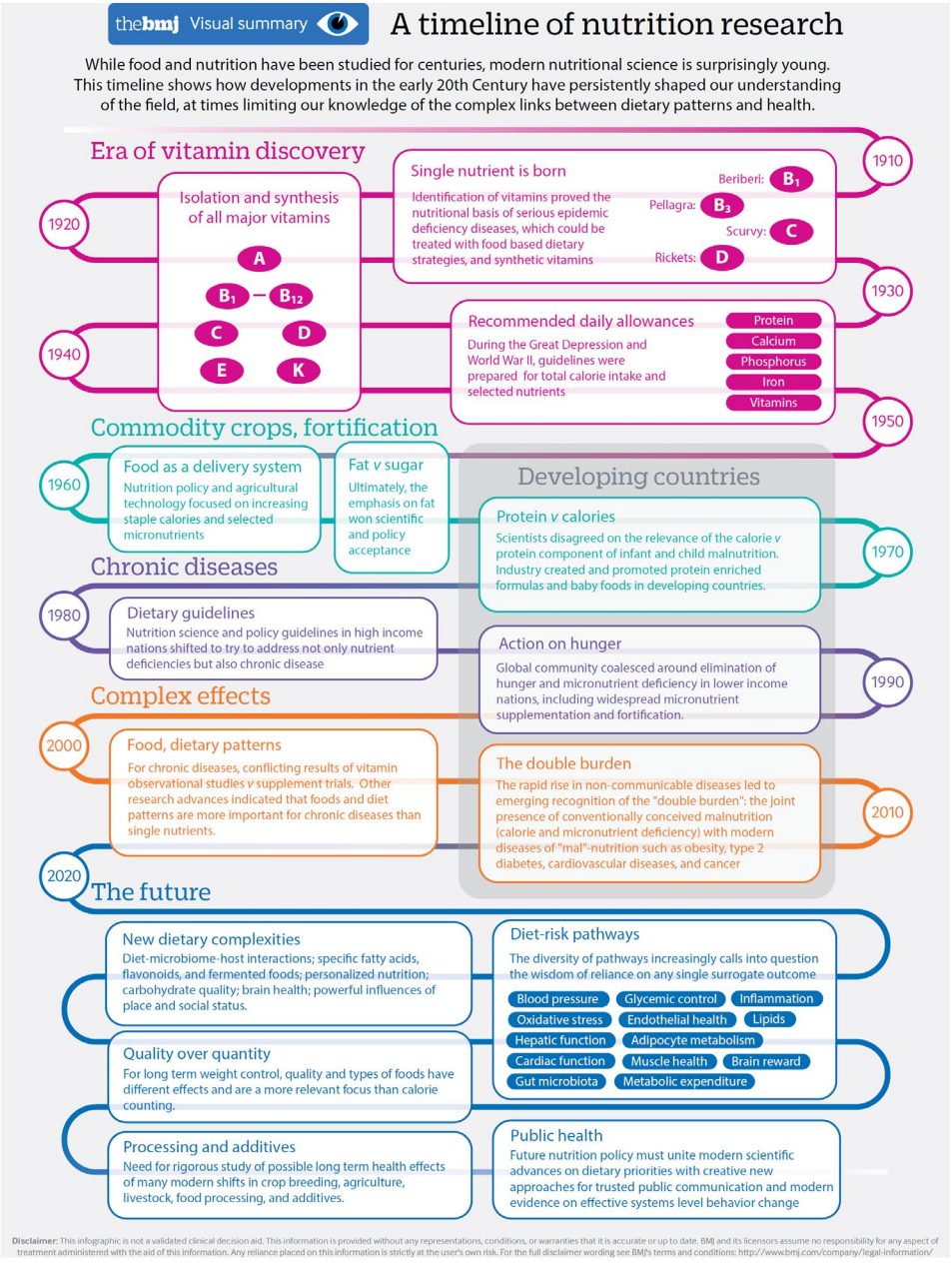
The Giessen Declaration

‘Nutrition science is defined as
the study of food systems, foods and drinks,
and their nutrients and other constituents;
and of their interactions within and between
all relevant biological,
social and environmental systems’

The Giessen Declaration (2005) Public Health Nutr 8(6A):783–786

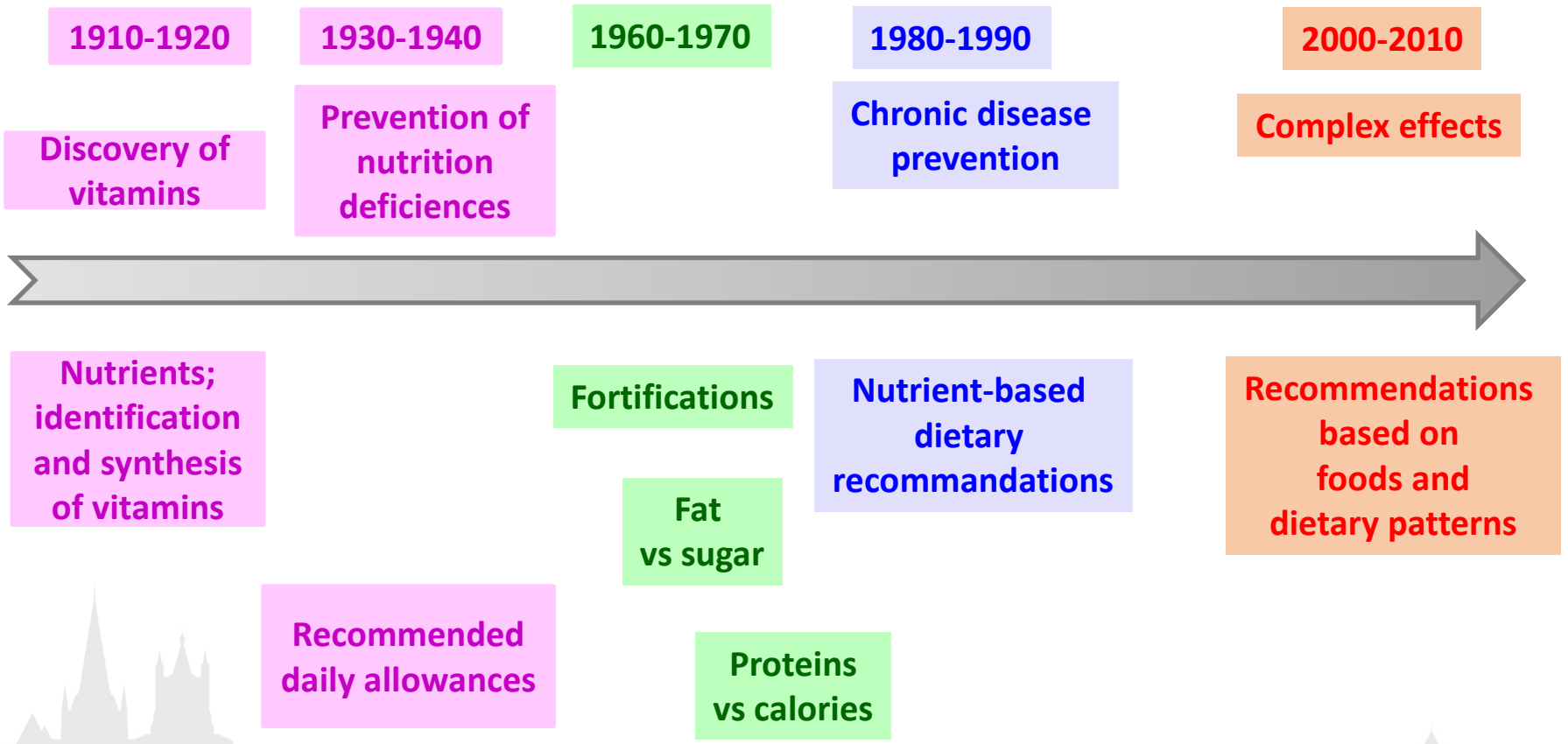
Nutrition science: historical perspective



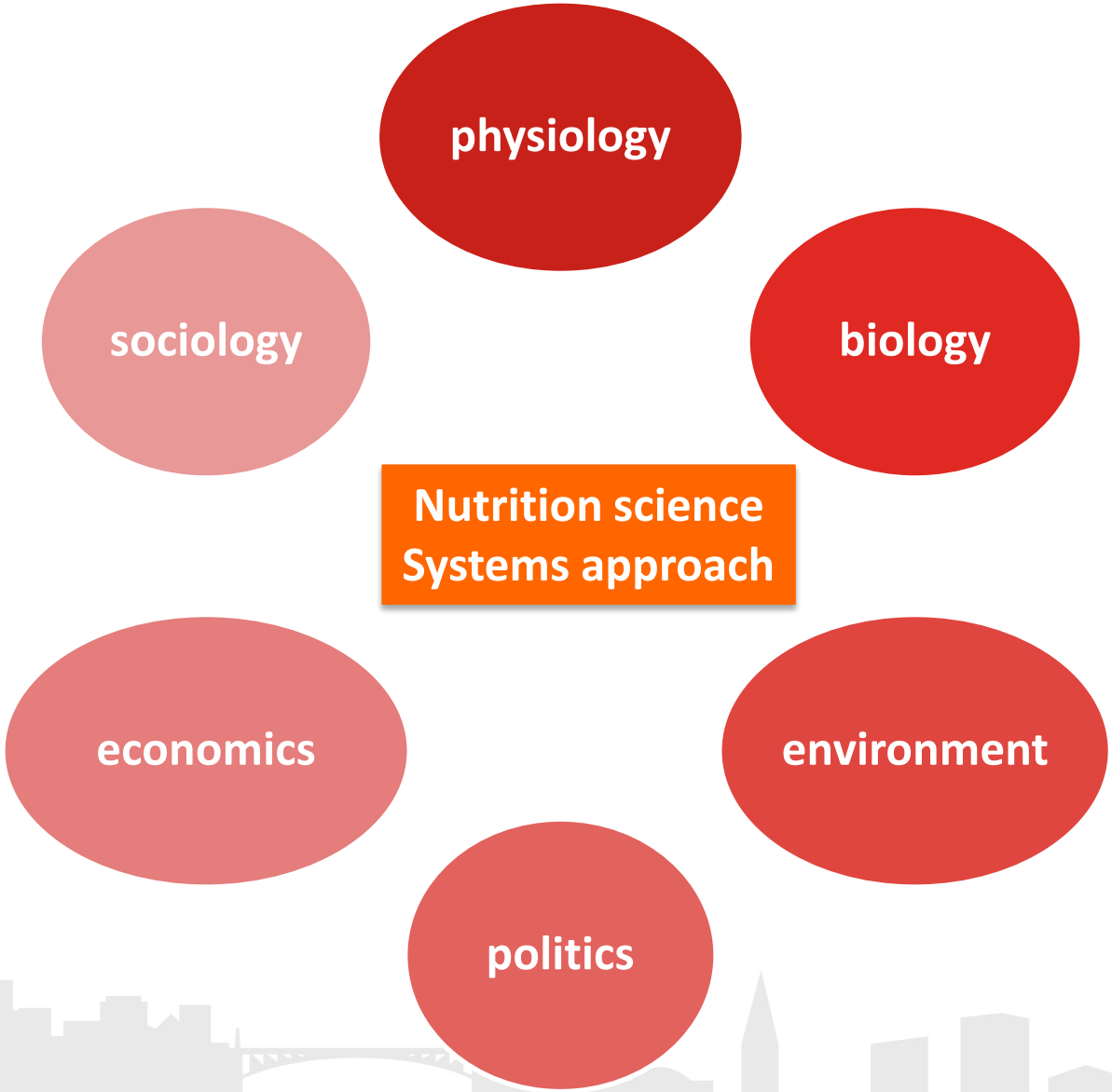


Mozaffarian, BMJ 2018; history of modern nutrition science

Key dates in nutrition science



Mozaffarian, BMJ 2018; history of modern nutrition science

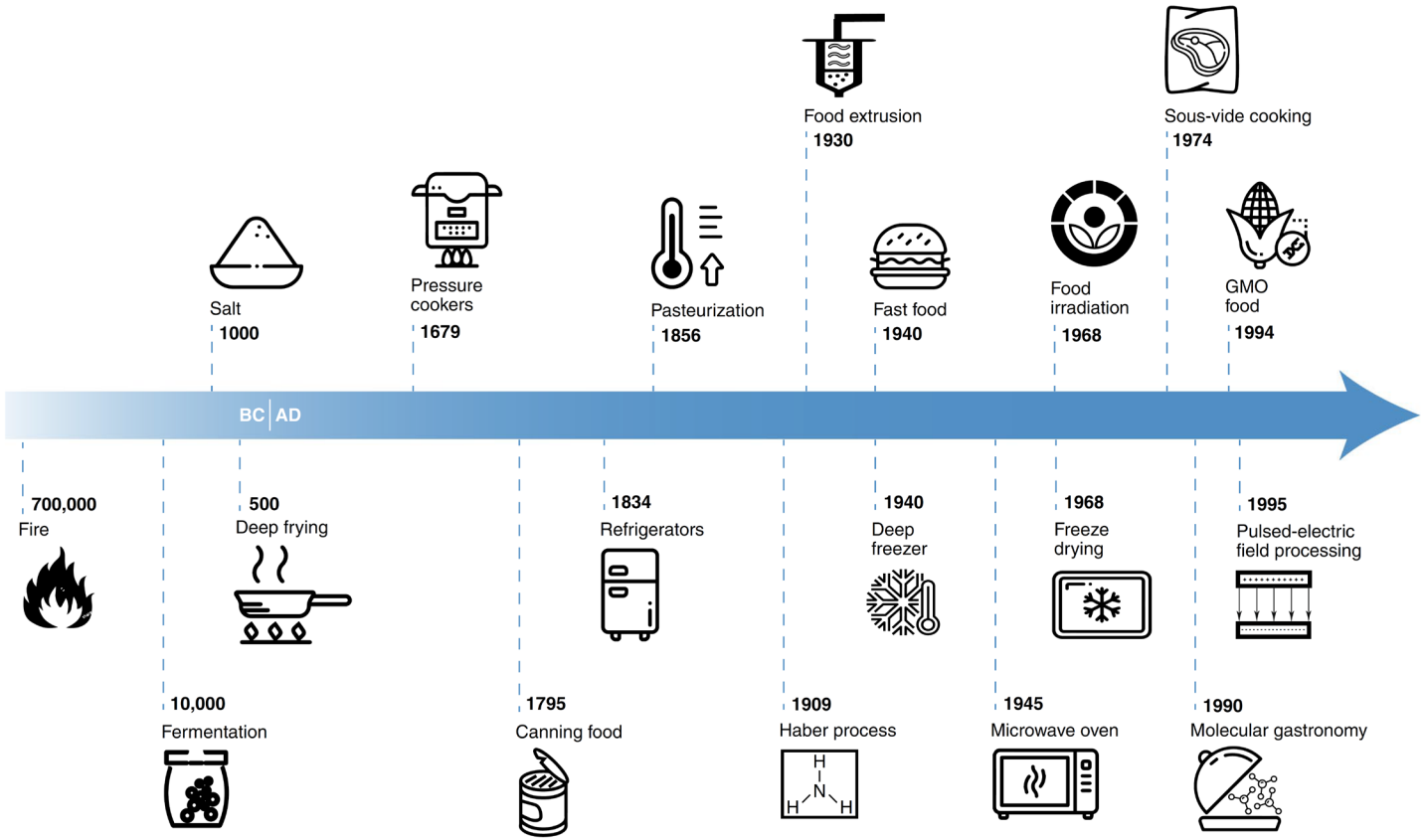

physiology
sociology
biology
Nutrition science
Systems approach
economics
environment
politics

Permanent lifelong massive exposure to food

60’000-90’000 Kg

20 Kg

History of food transforming technologies

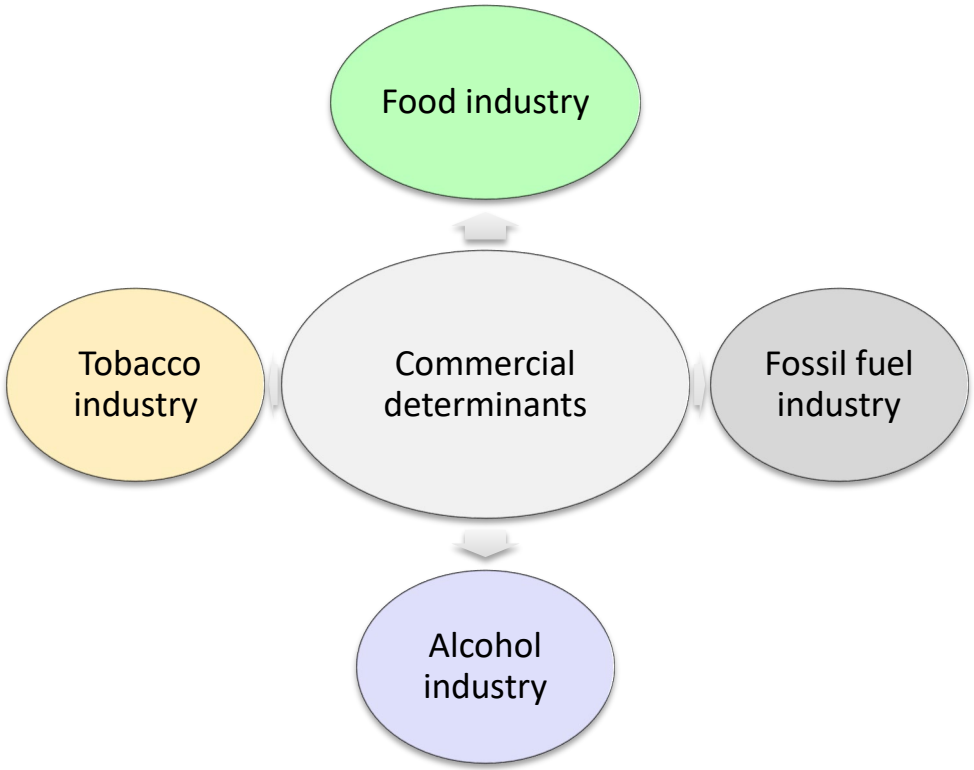


Sigriest & Hartmann, Nature Food 2020; 1; 343-350

Health determinants

Dahlgren, G. and Whitehead, M. (1993) Tackling inequalities in health: what can we learn from what has been tried?

Commercial determinants of health (CDOH)



Gilmore et al, Defining and conceptualising the commercial determinants of health, Lancet 2023.

The political and commercial determinants of nutritional health.

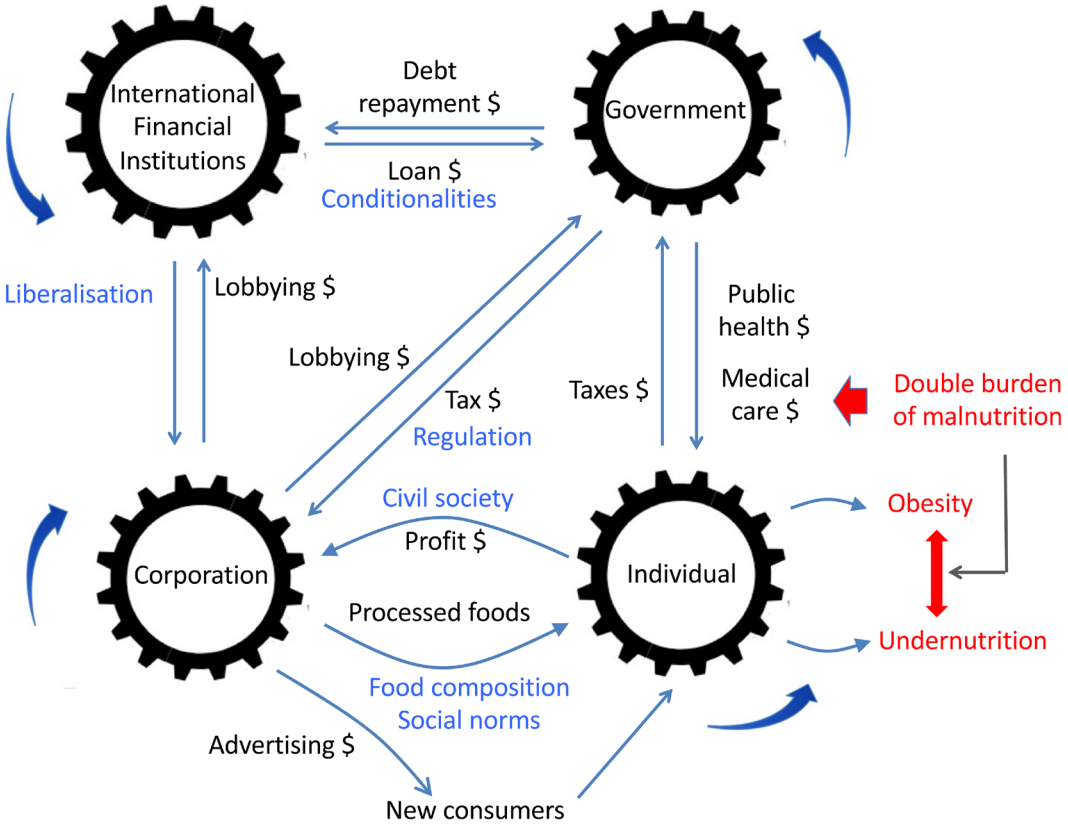
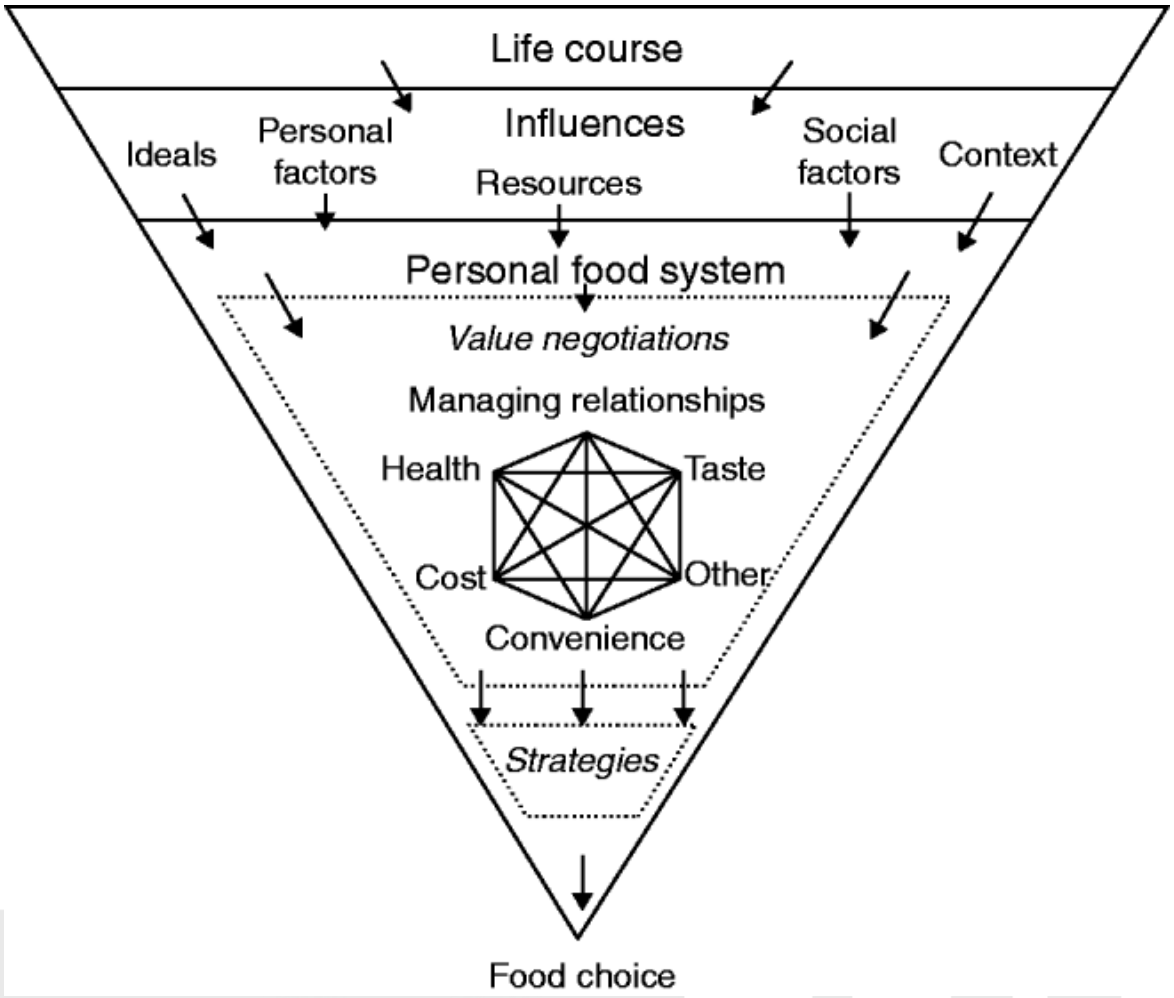


Fig. 7 The political and commercial determinants of nutritional health. The nutritional status of individuals is strongly shaped by asymmetric power dynamics and financial flows among a set of actors, including corporations, governments and supranational organisation. In contemporary food systems, these dynamics drive the double burden of malnutrition. Black text – financial flows; blue text – power relations; red text – markers of ill-health

Wells et al. Globalization and Health (2021) 17:119

Complexity of food choices



PMID: 11358343, Appetite 2001

Impact of psychosocial stress on appetite, metabolism and the food system.

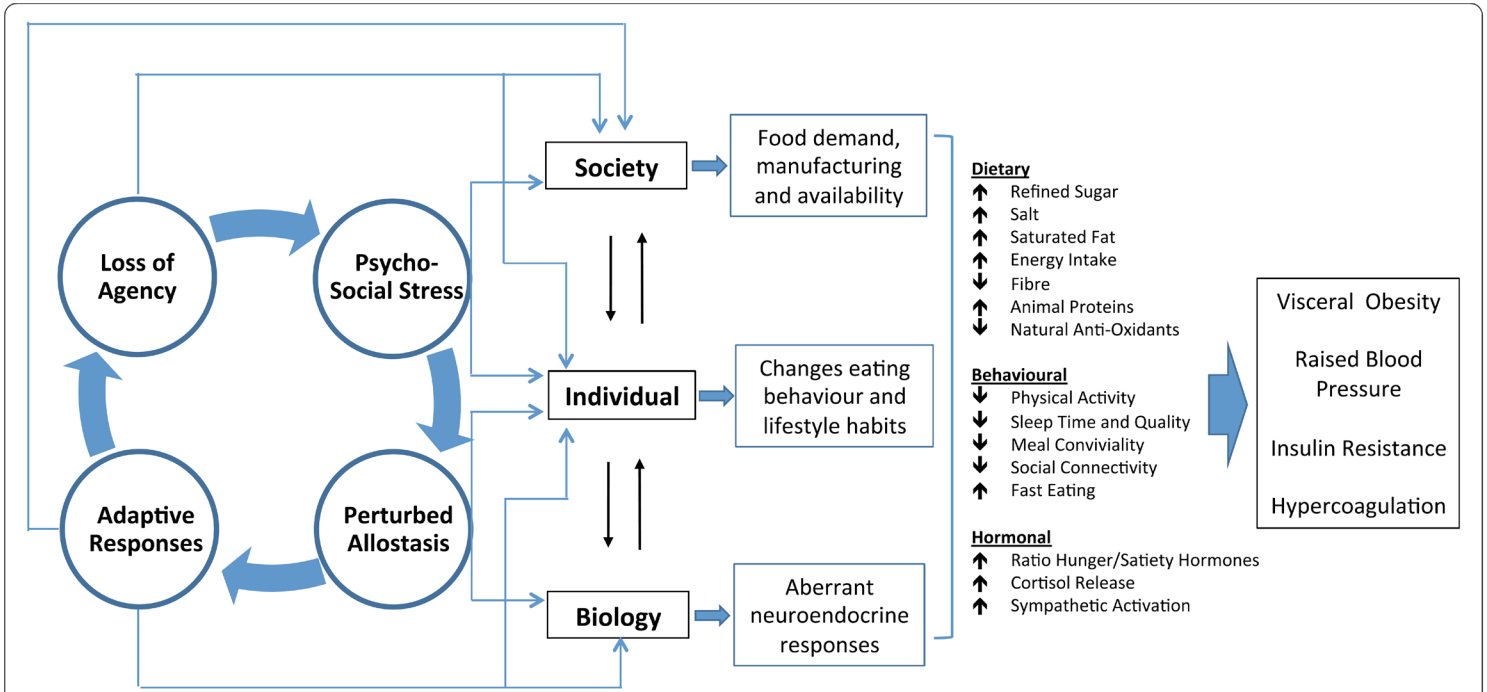


Fig. 5 Impact of psychosocial stress on appetite, metabolism and the food system. Stressed individuals experience increased appetite, and consume high-energy palatable foods to dampen the stress response, under the influence of complex metabolic pathways involving the hormone cortisol and other signalling molecules. Within the body, these metabolic responses are associated with poorer cardio-metabolic profile, including insulin resistance, elevated blood pressure and greater susceptibility to blood clots (hypercoagulation). Insulin resistance and sustained increases in appetite also lead to excess weight gain, leading to chronically increased food intake. However, there are also many broader changes in behaviour, including perturbed sleep patterns and lower levels of physical activity, as well as faster eating behaviour and reduced sociality around meals. The interaction between stress and appetite generates an overall increased demand for high-energy palatable products, which drives greater supply, thus increasing the availability of unhealthy foods

Wells et al. Globalization and Health (2021) 17:119

Individual-centric vs system-centric models of nutrition and agency

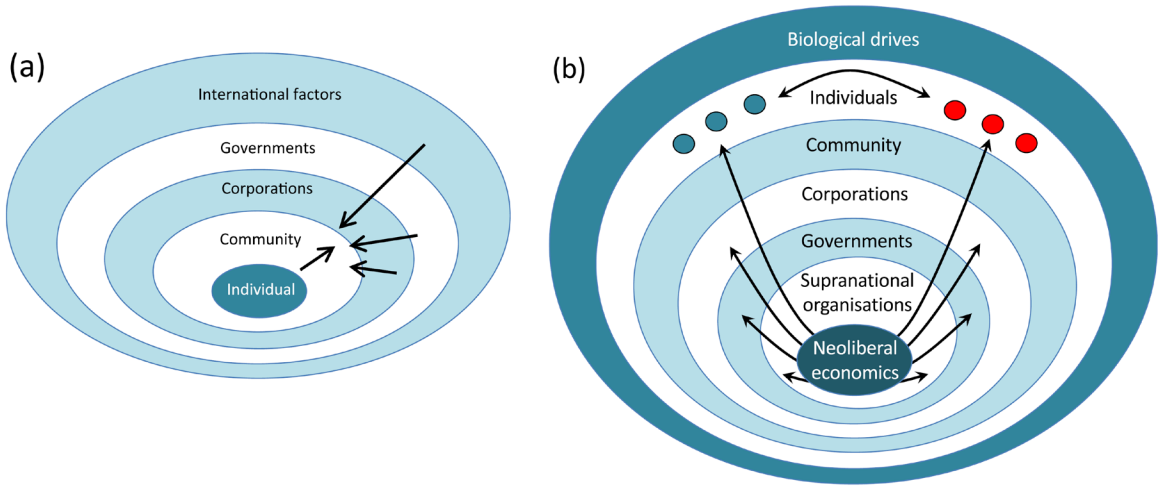
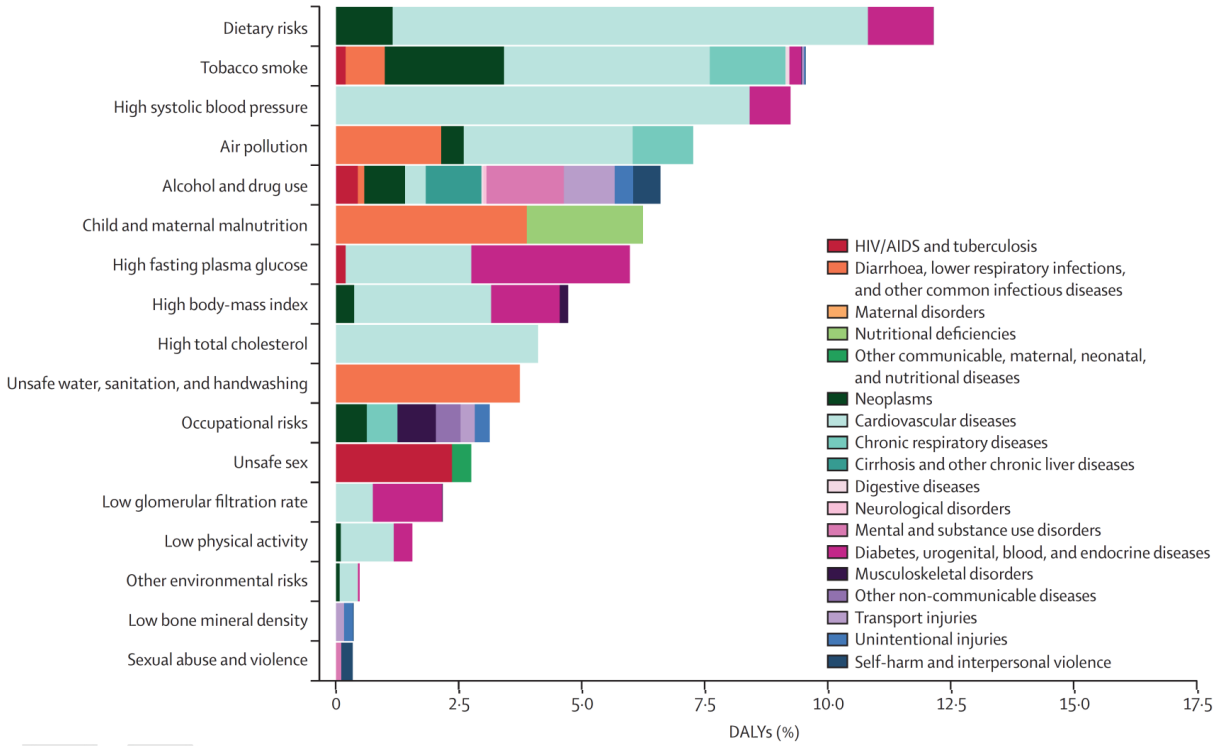


Fig. 8 Contrasting socio-ecological models of nutrition and agency. (**a**) The individual-centric view emphasises the individual, whose behavioural agency drives interactions with the social community, corporations and government activities. (**b**) The system-centric view emphasises the food environment as a system shaped by the logic of market economics. The overall system shapes government and corporate activities, and generates structural associations between different socio-economic groups (shown by red or green filled circles), whose biological drives are exposed to contrasting nutritional experience through the life-course

Wells et al. Globalization and Health (2021) 17:119

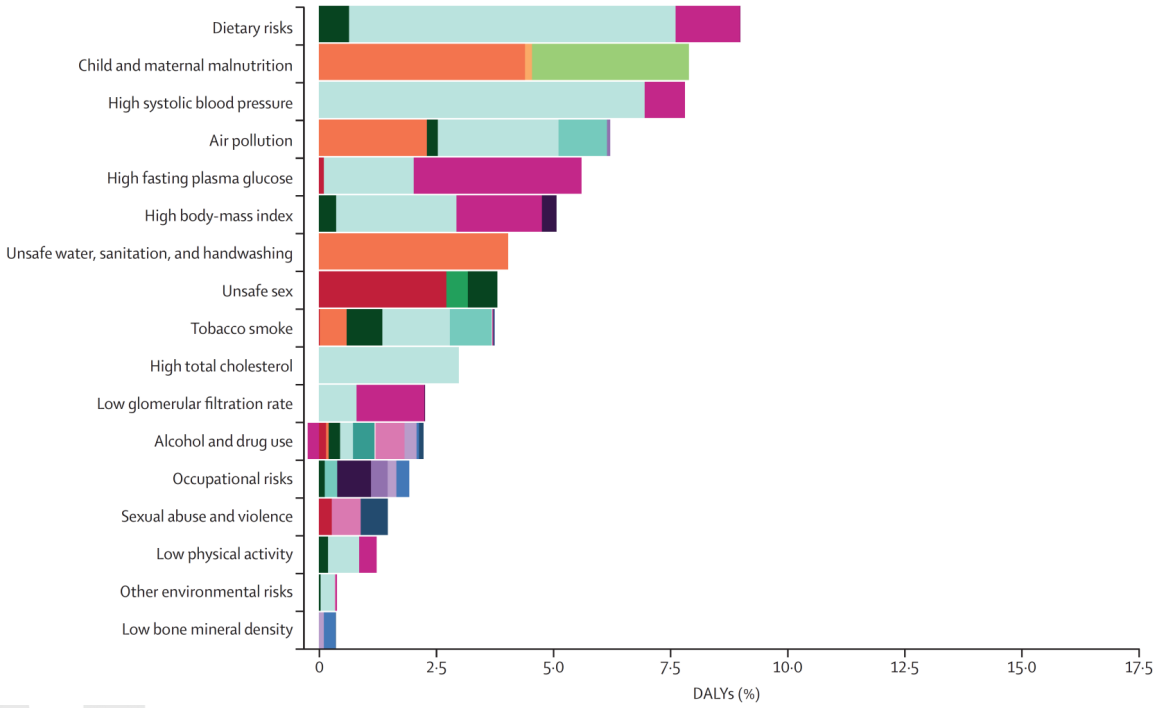
Risk factors and burden of disease in men (Global burden of disease study 2015)



DALY = disability-adjusted life years (années de vie ajustée sur l'incapacité)

Lancet 2016;**388**(10053):1659-1724

Risk factors and burden of disease in women (Global burden of disease study 2015)



DALY = disability-adjusted life years (années de vie ajustée sur l'incapacité)

Lancet 2016;**388**(10053):1659-1724

The food is medicine pyramide

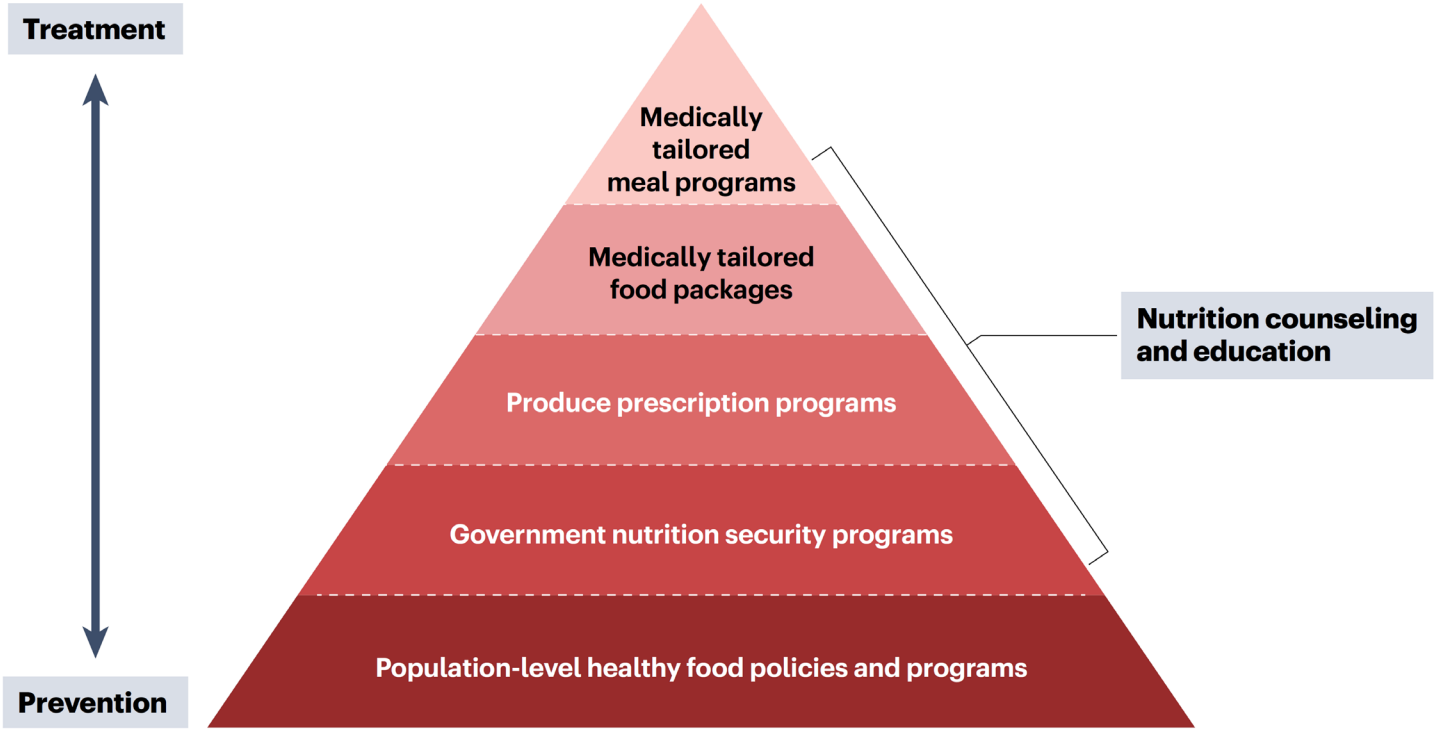


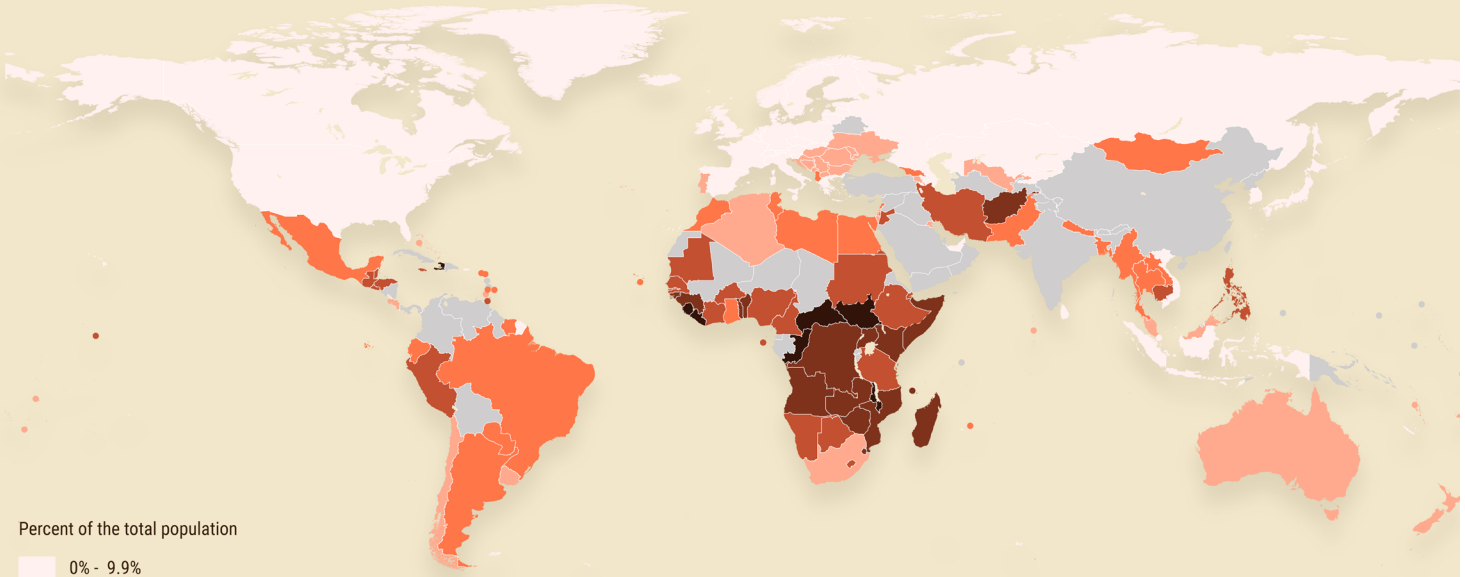
Fig. 1 | The Food is Medicine pyramid. An evolving framework of programs and interventions in healthcare and population health to integrate food-based nutrition interventions at multiple levels for specific health needs of different focus populations. Nutrition security programs include the Supplemental Nutrition Assistance Program (SNAP), Special Supplemental Nutrition Program for Women, Infants and Children (WIC), and school meals. Figure adapted and updated from Food is Medicine Massachusetts (https://foodismedicinema.org/food-is-medicine-interventions).

Food and Agriculture Organization of the United Nations

FAO FOOD INSECURITY MAP

Prevalence of Moderate or Severe Food Insecurity
SDG Indicator 2.1.2

SUSTAINABLE DEVELOPMENT GOALS



Percent of the total population

- 0% - 9.9%
- 10% - 24.9%
- 25% - 39.9%
- 40% - 59.9%
- 60% - 79.9%
- 80% - 100%
- Data not available or not country validated

Source: FAO, IFAD, UNICEF, WFP and WHO. 2022. *The State of Food Security and Nutrition in the World 2022. Repurposing food and agricultural policies to make healthy diets more affordable.* Data are available on FAOSTAT (**https://www.fao.org/faostat/en/#data/FS**)

The boundaries and names shown and the designations used on these map(s) do not imply the expression of any opinion whatsoever on the part of FAO concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers and boundaries. Dashed lines on maps represent approximate border lines for which there may not yet be full agreement.

Final boundary between the Republic of Sudan and the Republic of South Sudan has not yet been determined. Dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties.

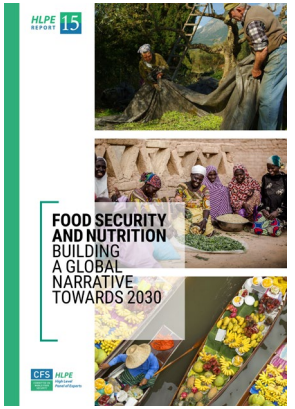


FIGURE 1

IDENTIFYING SIX DIMENSIONS OF FOOD SECURITY IN ITS CURRENT DEFINITION

AGENCY
STABILITY (SHORT TERM)
SUSTAINABILITY (LONG TERM)
ACCESS
AVAILABILITY
UTILIZATION

"Food security (is) a situation that exists when
ALL PEOPLE,
AT ALL TIMES, *have*
PHYSICAL, SOCIAL AND ECONOMIC ACCESS *to*
SUFFICIENT,
SAFE AND NUTRITIOUS *food that meets their*
DIETARY NEEDS *and*
FOOD PREFERENCES
for an active and healthy life."

HLPE. 2020. *Food security and nutrition: building a global narrative towards 2030.* A report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, Rome.

BOX 1
THE SIX DIMENSIONS OF FOOD SECURITY

Availability	Having a quantity and quality of food sufficient to satisfy the dietary needs of individuals, free from adverse substances and acceptable within a given culture, supplied through domestic production or imports.
Access (economic, social and physical)	Having personal or household financial means to acquire food for an adequate diet at a level to ensure that satisfaction of other basic needs are not threatened or compromised; and that adequate food is accessible to everyone, including vulnerable individuals and groups.
Utilization	Having an adequate diet, clean water, sanitation and health care to reach a state of nutritional well-being where all physiological needs are met.
Stability	Having the ability to ensure food security in the event of sudden shocks (e.g. an economic, health, conflict or climatic crisis) or cyclical events (e.g. seasonal food insecurity).
Agency	Individuals or groups having the capacity to act independently to make choices about what they eat, the foods they produce, how that food is produced, processed, and distributed, and to engage in policy processes that shape food systems. The protection of agency requires socio-political systems that uphold governance structures that enable the achievement of FSN for all.
Sustainability	Food system practices that contribute to long-term regeneration of natural, social and economic systems, ensuring the food needs of the present generations are met without compromising the food needs of future generations.

HLPE. 2020. *Food security and nutrition: building a global narrative towards 2030.* A report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, Rome.

Food security and nutrition: building a global narrative towards 2030.

A report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, Rome. HLPE. 2020.

Food systems

All the elements (environment, people, inputs, processes, infrastructures, institutions, etc.) and activities that relate to the production, processing, distribution, preparation and consumption of food, and the output of these activities, including socio-economic and environmental outcomes" (HLPE 8, 2014).

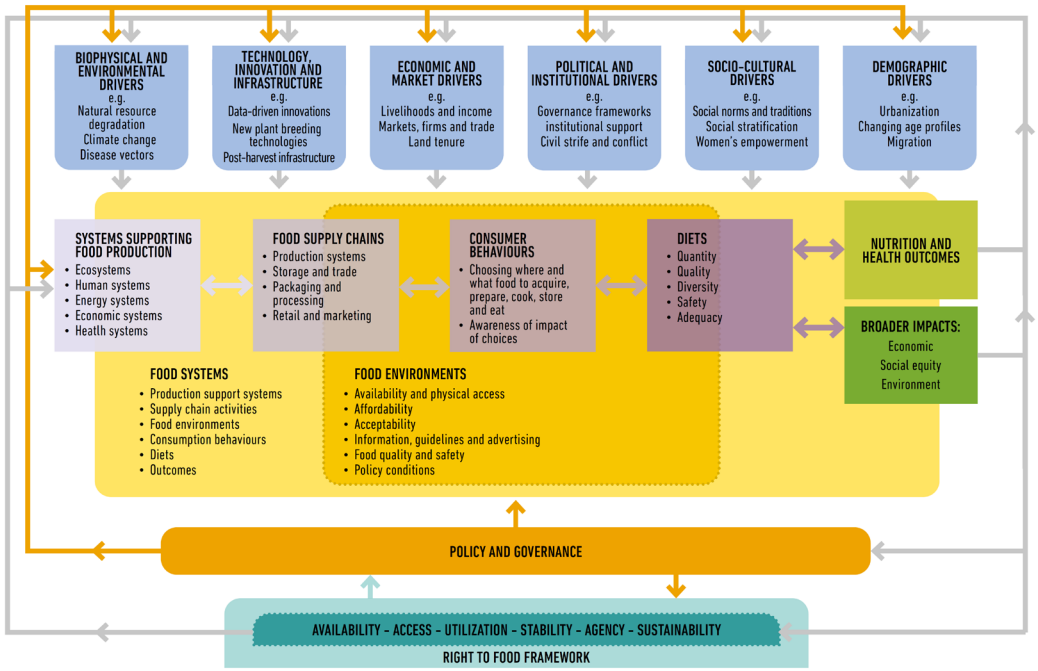
The three constituent elements of food systems are:

- food supply chains,

- food environments and

- consumer behaviour. (HLPE 12, 2017).

FIGURE 2
SUSTAINABLE FOOD SYSTEM FRAMEWORK



SOURCE: ADAPTED FROM HLPE 12, 2017

Federal Food Chain Unit in Switzerland
(FOAB+FSVO)

The Federal Food Chain Unit (FFCU) supports the Federal Office of Agriculture (FOAG) and the FSVO in supervising the implementation within Switzerland of legislation in the areas of plant health, food and feed, animal diseases and animal welfare.

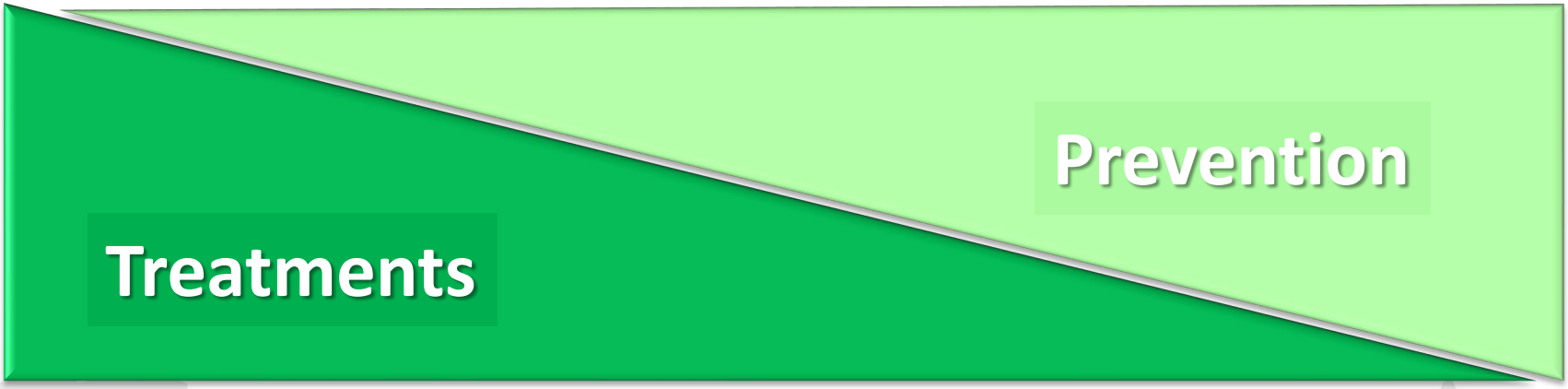
www.blv.admin.ch

Strategic objectives along the food chain in Switzerland

https://www.blv.admin.ch/blv/fr/home/das-blv/organisation/blk/nationaler-kontrollplan.html

From populations to individuals and vice versa

Personalized approaches | **Individual-based approaches** | **Population-based approaches**



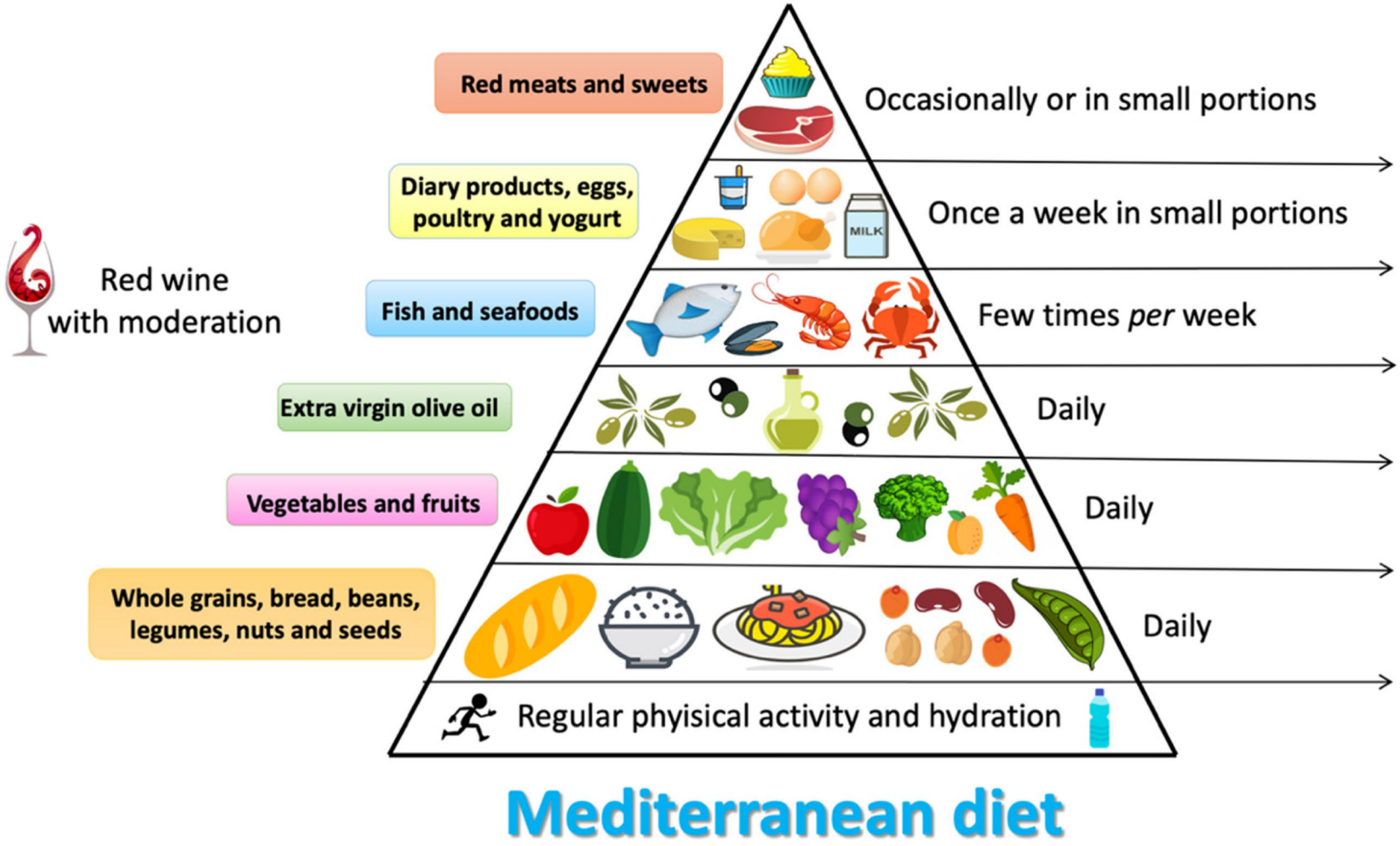


Figure 1. Characteristics of Mediterranean diet.

Merra et al, Nutrients 2021, 13, 7.

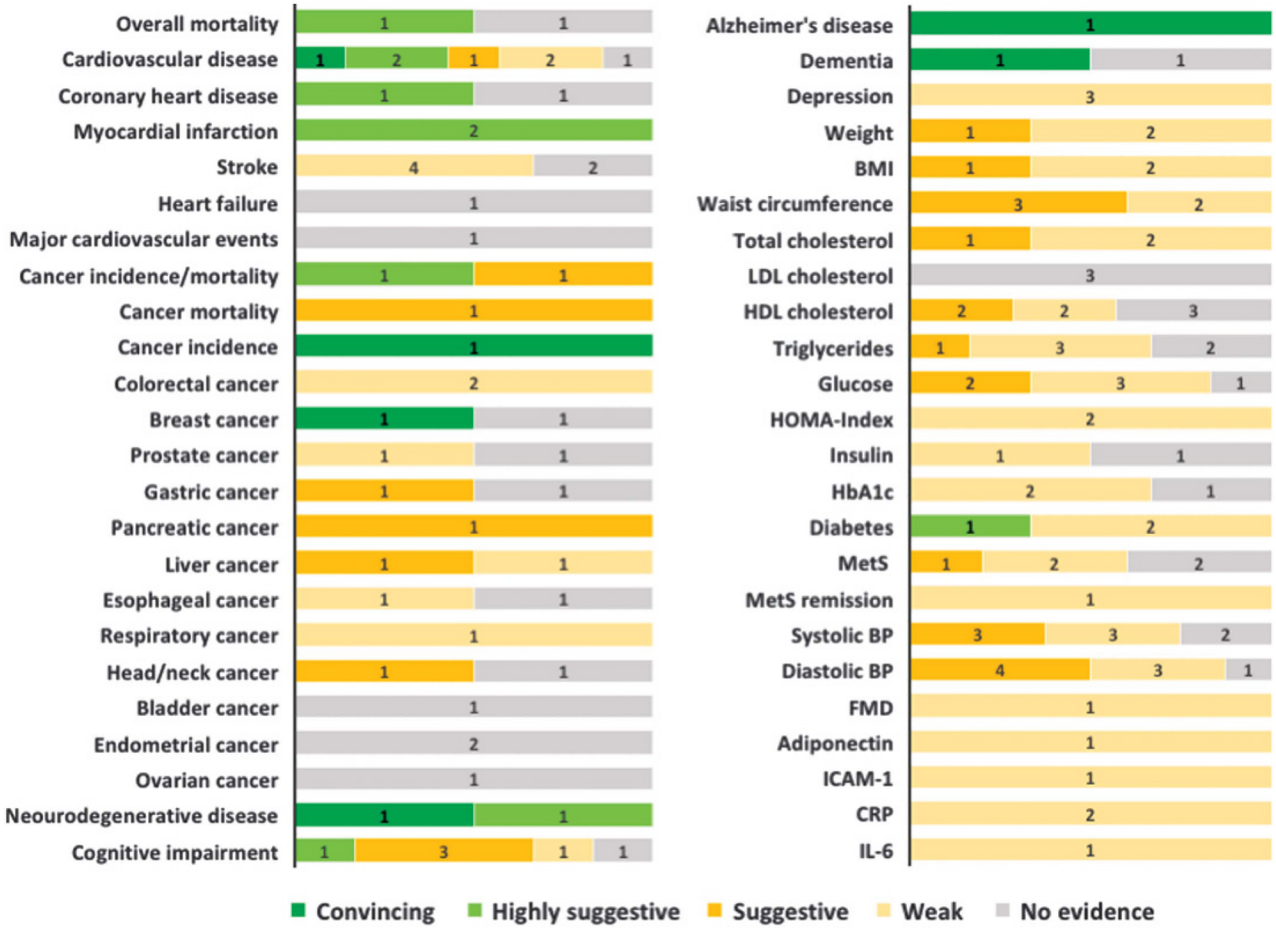


Figure 4. Summary of the strength of evidence for the evaluated health outcomes. Numbers indicate the number of meta-analyses with convincing, highly suggestive, suggestive, weak or no evidence for each outcome.

Dinu, M.; Pagliai, G.; Casini, A.; Sofi, F. Mediterranean diet and multiple health outcomes: An umbrella review of meta-analyses of observational studies and randomised trials. Eur. J. Clin. Nutr. **2018**, 72, 30–43.

Ultra-processed foods and health

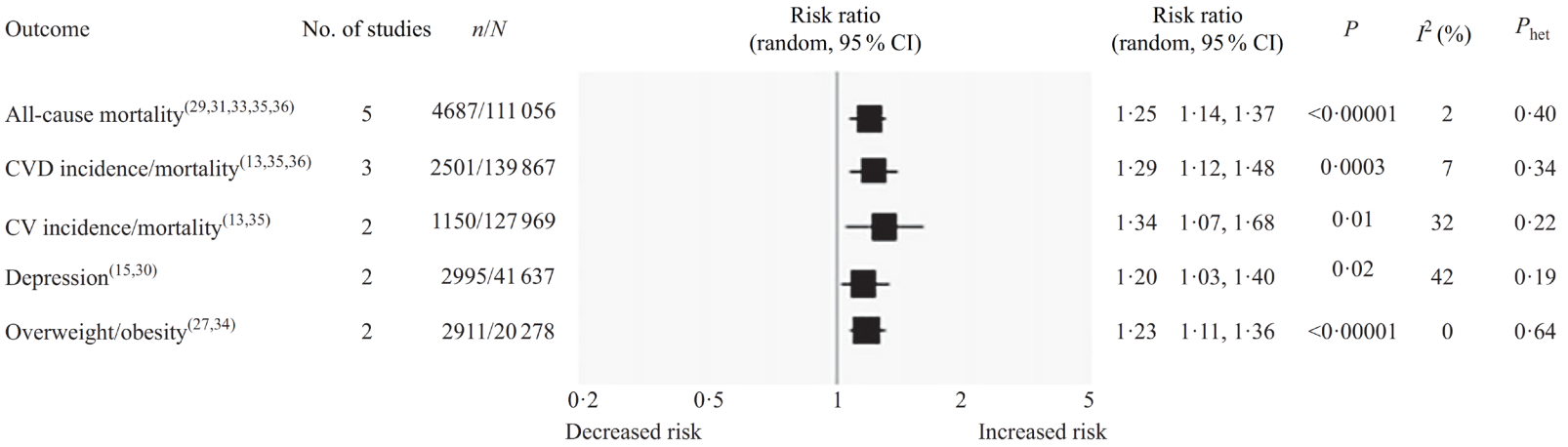


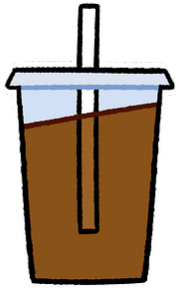
Fig. 3. Forest plot of prospective cohort studies investigating the association between ultra-processed foods consumption and different health outcomes. *P* value is for *Z* test of no overall association between exposure and outcome; P_{het} is for test of no differences in association measure among studies; I^2 estimates from heterogeneity rather than sampling error. CV, cerebrovascular.

Ultra-processed foods (UPF) are, according to the NOVA classification, 'formulations of ingredients, mostly for industrial use only, derived from a series of industrial processes'.

Ultra-processed foods usually contain ingredients that you wouldn't add when cooking homemade food. You may not recognise the names of these ingredients as many will be chemicals, colourings, sweeteners and preservatives.

Paglia et al. Br J Nutr 2021; 125, 308-318

Ultra-processed foods



breakfast cereals, savoury snacks, reconstituted meat products, frankfurters, pre-packaged frozen dishes, soft and/or sweetened drinks, distilled alcoholic beverages and supplements.

NOVA classification

Group 1. Unprocessed or minimally processed foods: fresh, squeezed, chilled, frozen or dried fruits and leafy and root vegetables; grains such as brown, parboiled or white rice, corn cob or kernel, wheat berry or grain; legumes such as beans of all types, lentils, chickpeas, potatoes, meat, poultry, fish and seafood, eggs, milk, pasta, couscous and polenta made with flours, etc

Group 2. Processed culinary ingredients*:* vegetable oils; butter and lard obtained from milk and pork; starches extracted from corn and other plants; sugar and molasses obtained from cane or beet; honey extracted from combs and syrup from maple trees; and salt mined or from seawater.

Group 3. Processed foods: canned or bottled vegetables, fruits and legumes; salted or sugared nuts and seeds; salted, pickled, cured or smoked meats and other animal foods; canned fish; fruits in syrup; cheeses; and unpackaged freshly made bread*)*

Group 4. Ultra-processed foods: carbonated drinks; sweet or savoury packaged snacks; ice cream, chocolate, candies (confectionery); mass-produced packaged breads, buns, cookies (biscuits), pastries, cakes; breakfast 'cereals', 'cereal' and 'energy' bars; margarines and spreads; processed cheese; pre-prepared pies and pasta and pizza dishes; poultry and fish 'nuggets' and 'sticks'; sausages, burgers, hot dogs and other reconstituted meat products; etc

https://fr.openfoodfacts.org/nova

Healthy and sustainable diets
(FAO and WHO, 2019)

Healthy and sustainable diets refer to dietary patterns that fulfil the aims of the guiding principles of sustainable healthy diets, namely:

- promote all dimensions of individuals' health and wellbeing,
- have low environmental pressure and impact,
- are accessible, affordable, safe and equitable, and
- are culturally acceptable.

http://www.fao.org/3/ca6640en/ca6640en.pdf

The Planetary Health Diet

A healthy global diet should include around half a plate of fruit and vegetables by volume; the other half, expressed in calories, consists mainly of whole grains, vegetable proteins, unsaturated vegetable oils and (possibly) animal proteins in moderate quantities.

EAT Lancet Commission 2019

EAT is the science-based global platform for food system transformation.

Methods to assess dietary exposure (self-report)

Method	Advantages	Disadvantages
Food record	Precise information on food consumption Not based on memory Precise estimation of quantities	Selection bias Burdensome for participants May modify dietary patterns Exposure misclassification
24h recall	High participation rate Does not interfere with usual diet Direct coding of food during the recall	Not representative of usual diet Incomplete recall Need for trained investigators Expensive
Food frequency questionnaire (FFQ)	Low cost Easy to use and complete Individuals classified according to food intakes Usual consumption	Questionnaire needs to be validated Data quality check and entry burdensome Lack of precision Important random errors.
Diet history	Study of nutritional profile Usual repartition of consumptions Characterizes ways to prepare foods and circumstances of food intake Usual consumption	Long duration Omission of selected food intakes. Need for trained investigators

Serum biomarkers of nutrition status

- **Fatty acids:** butyric acid, myristic acid , linoleic acid C18:2, etc
- **Amino acids and derived molecules:** alanine, arginine, etc
- **Minerals / Elements:** Na, Mg, Cl, K, Ca, Fe, Zn, Cu, etc
- **Hydrosoluble vitamins**: vitamin B_1, vitamin B_2, vitamin B_6, vitamin B_{12} etc.
- **Liposoluble vitamins**: ADEK
- **Iron status:** iron, ferritin, transferrin, Unsaturated Iron Binding Capacity
- **Thyroid function:** TSH, T3/T4
- **Lipids:** total cholesterol, triglycerides, etc
- **Others:** albumin, pre-albumin, total protein, glucose, insulin, urea, liver enzymes, creatinine, bilirubin, etc

Urine biomarkers of nutrition status

- **Minerals:** urinary Na, K, I, PO4, Mg excretions in 24h urine or concentration and ratio with creatinine in spot urine (etc)
- **Other:** urinay urea, urate and creatinine excretions (24h urine).

WHO indicators of nutritional status

Biomarker	Role
C-reactive protein	marker of inflammation or infection for interpreting biomarkers of micronutrient status
Goitre	determinant of the prevalence and severity of iodine deficiency disorders in populations
Haemoglobin	diagnosis of anaemia and assessment of severity
Serum ferritin	iron status and iron deficiency in populations.
Serum transferrin receptor levels	iron status and iron deficiency in populations
Serum retinol	prevalence of vitamin A deficiency in populations.
Serum and red blood cell folate	folate status in populations
Urinary iodine concentrations	determining iodine status in populations
Xerophthalmia and night blindness	clinical vitamin A deficiency in individuals and populations

http://www.who.int/vmnis/indicators/en/

Swiss Food Pyramide (2024)

The Swiss Food Pyramide presents an image of a balanced diet

Beverages ▶ Drink regularly. Water is best.
1–2 litres per day

Fruit and vegetables ▶ Colourful and seasonal.
5 portions per day

Cereal products and potatoes ▶ Focus on wholegrain products.
3 portions per day

Dairy products ▶ Preferably unsweetened.
2–3 portions per day

Pulses, eggs, meat and others ▶ Enjoy the variety. More pulses.
1 portion per day

Nuts and seeds ▶ Daily in small quantities.
1 small handful per day

Oils and fats ▶ Vegetable oils are preferable.
2 tablespoons per day

Sweetened beverages, sweets and salty snacks (optional) ▶ In small quantities.
0–1 portion per day

http://www.sge-ssn.ch/fr/

Habitudes alimentaires en Suisse*

Sucreries, snacks salés & alcool ★———

On consomme chaque jour environ 4 portions au lieu d'une.

Huiles, matières grasses & fruits à coque ★★★—

Mais on consomme chaque jour trop de graisses animales.

Produits laitiers, viande, poisson, œufs & tofu ★———

On consomme chaque jour seulement 2 portions de produits laitiers au lieu de 3, et trop de viande.

Produits céréaliers, pommes de terre & légumineuses ★★★—

On consomme chaque jour 2,4 portions au lieu de 3.

Légumes & fruits ★★——

On consomme chaque jour 3 à 4 portions au lieu de 5.

Boissons ★★★★

On boit chaque jour 1 à 2 litres (eau, café, thé).

*Selon l'enquête nationale sur l'alimentation menuCH

https://www.blv.admin.ch/blv/fr/home/lebensmittel-und-ernaehrung/ernaehrung/menuch/menu-ch-ergebnisse-ernaehrung.html

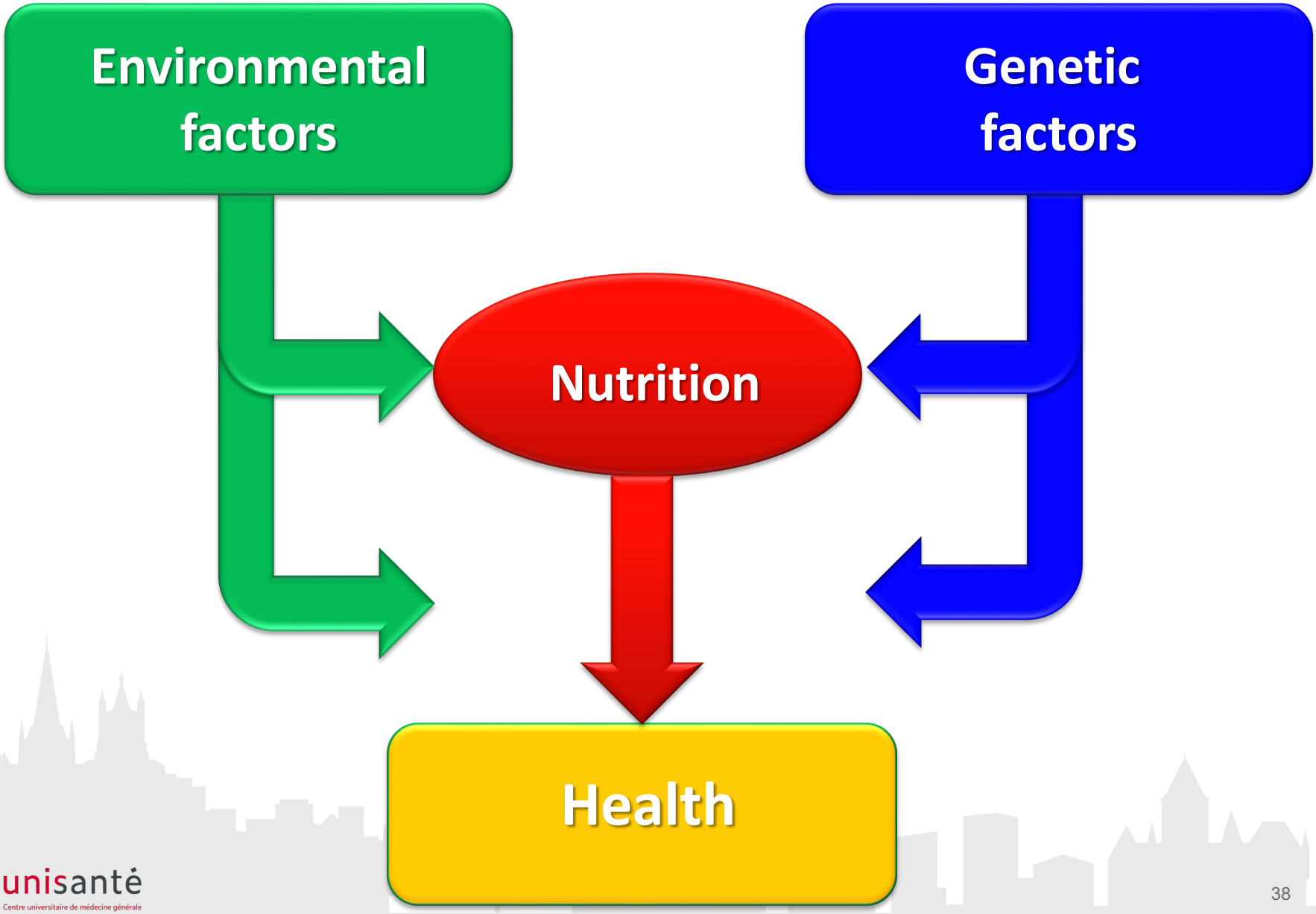

Environmental factors
Genetic factors
Nutrition
Health

Table 1. Genomics, precision medicine, and PPH: Definitions and comparisons.

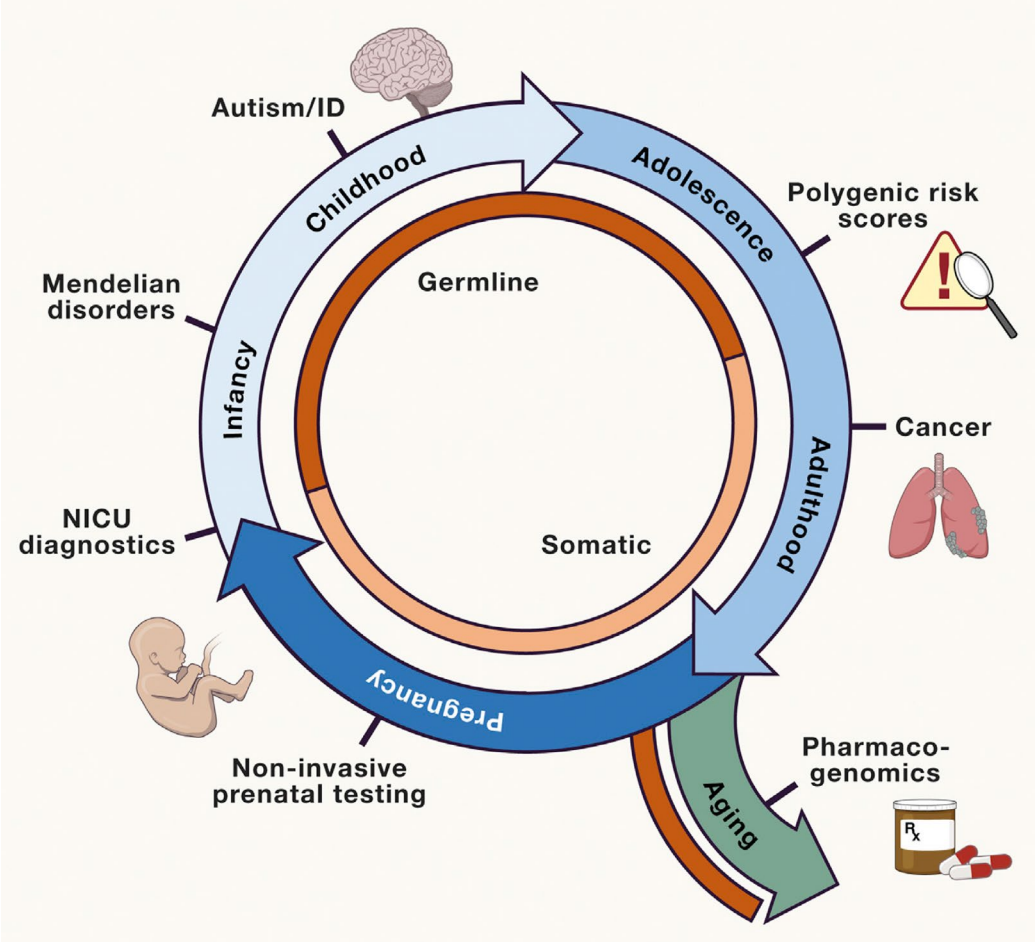
	Medicine	Public Health
	Medicine is the art and science of practice for diagnosing, treating, and preventing disease. [16]	**Public health** is "the science of protecting and improving the health of people and their communities." [17] What we as a society do collectively to ensure the conditions in which people can be healthy [18]
Genomics	**Genomic medicine** is an "emerging medical discipline that involves using genomic information about an individual as part of their clinical care." [19]	**Public health genomics** is a multidisciplinary field concerned with the responsible and effective translation of genome discoveries into improved population health." [20]
Precision	**Precision medicine** is "a novel approach to treatment and prevention that takes into account differences in lifestyle, environment, and biology." [12] The right intervention to the right patient at the right time.	**PPH** is a novel approach that uses big data science and technology to improve population health and reduce health disparities. The right intervention to the right population at the right time.

Abbreviation: PPH, precision public health

https://doi.org/10.1371/journal.pmed.1003373.t001

Khoury et al, PLoS Med (2020) 17(10): e1003373.

Genomic Medicine throughout the Human Life Cycle



Shendure et al, Cell 177, March 21, 2019

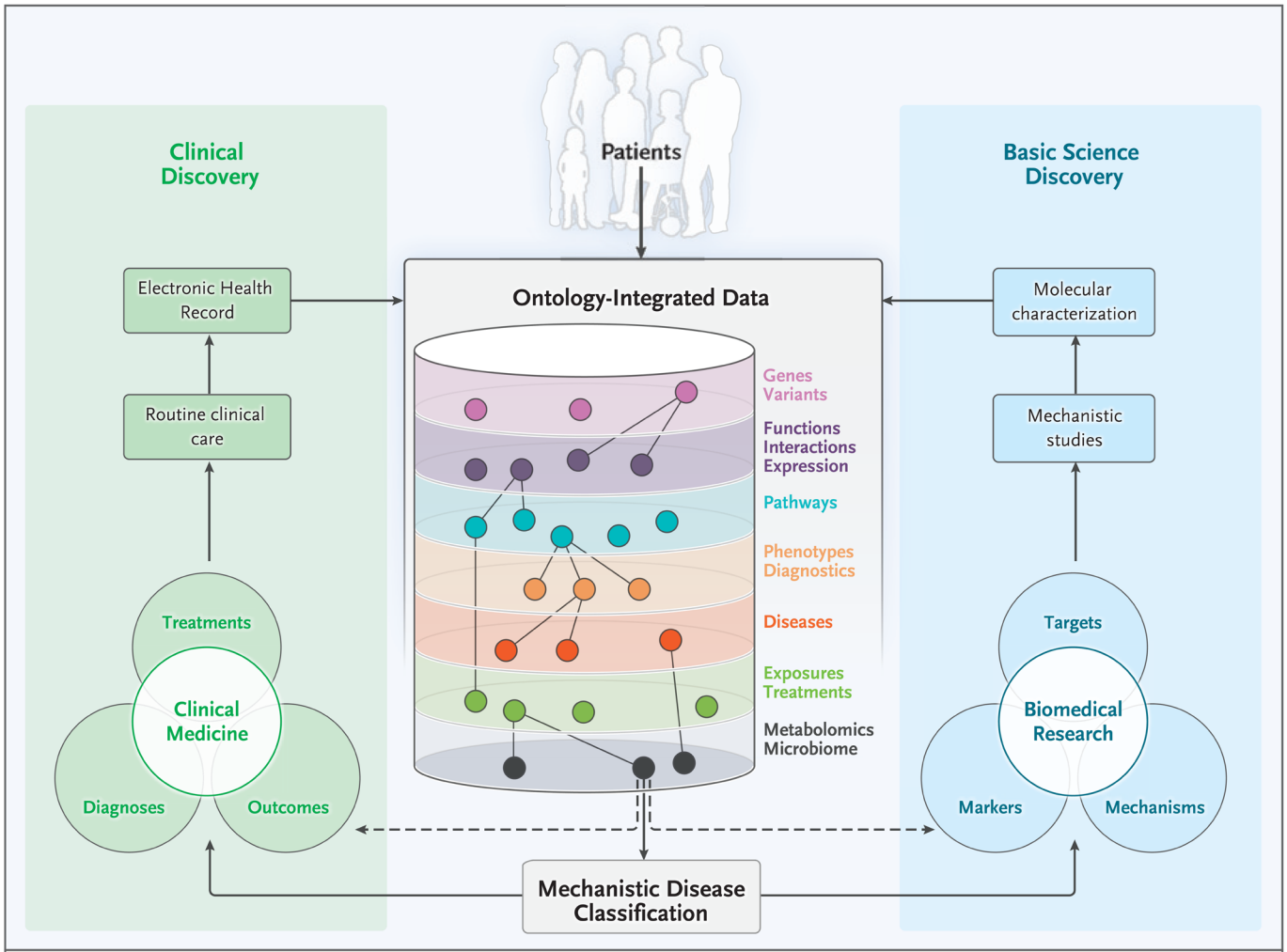


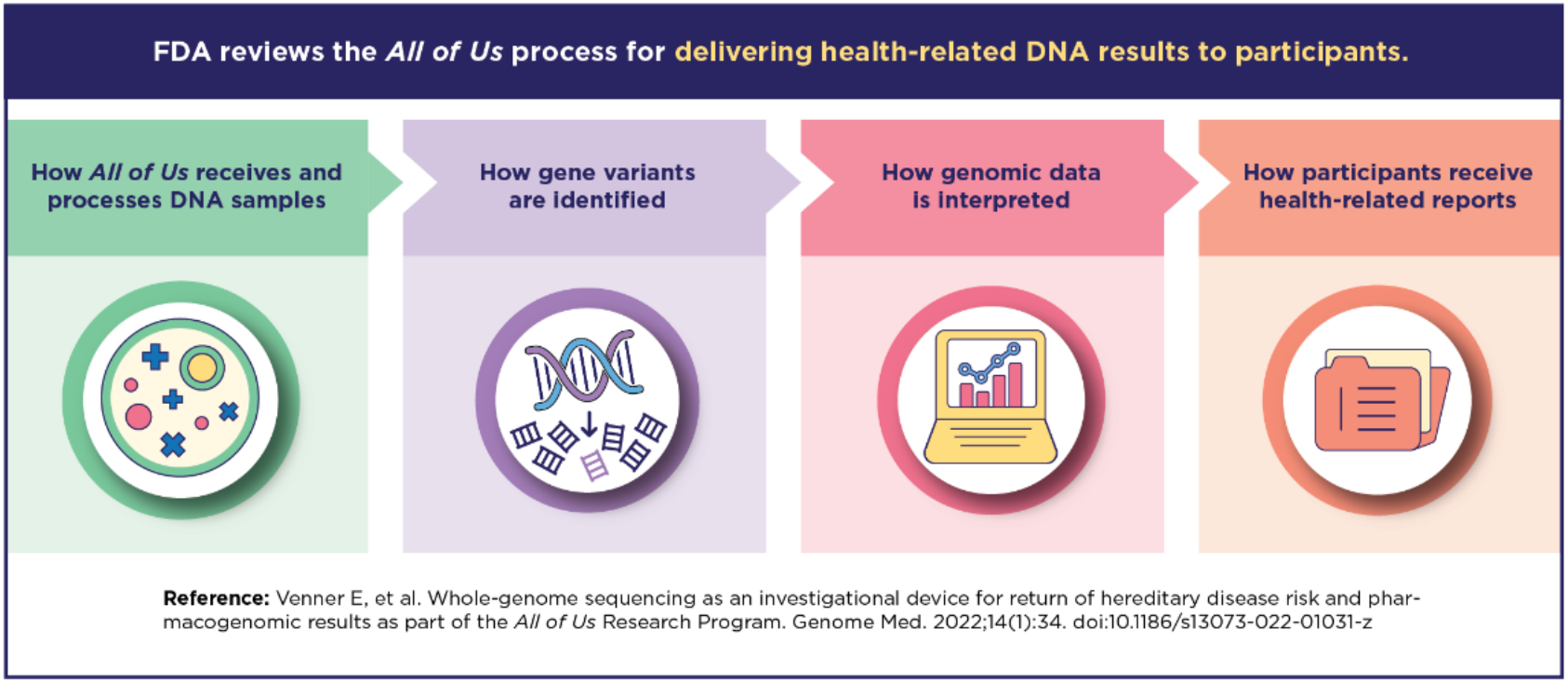
Figure 4. Ontology-Based Mechanistic Classification of Disease.

Well-structured clinical data can be readily integrated with discovery research data by using ontologies, which make clinical and basic science observations "computable" in a way that reflects present knowledge and allows new inferences. Integrating the two streams of data enables a mechanistic classification of disease across many data types, making a more refined and dynamic classification of patients possible.[1]

Haendel et al, N Engl J Med 2018;379:1452-62.

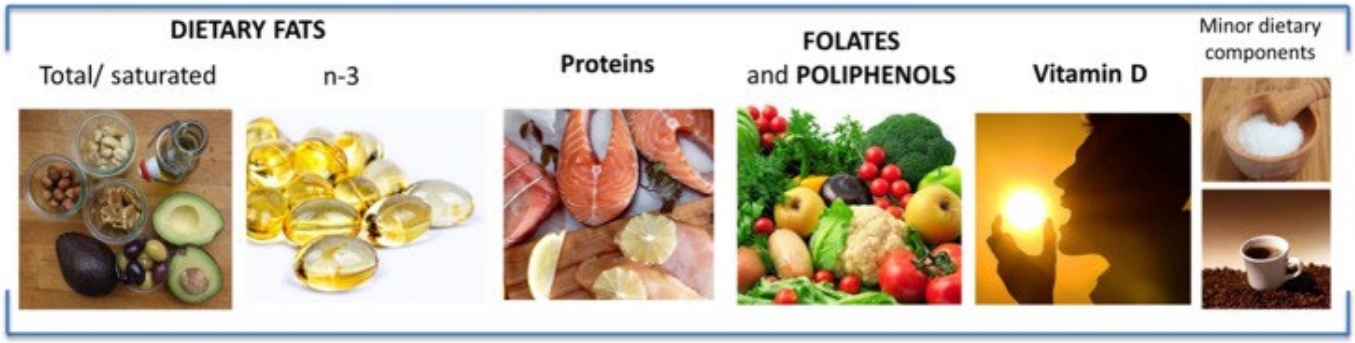
All of Us Meets FDA Standards to Deliver DNA Research Results to Participants

September 6, 2022



https://allofus.nih.gov/news-events/research-highlights/allofus-meets-fda-standards-dna-results-delivery

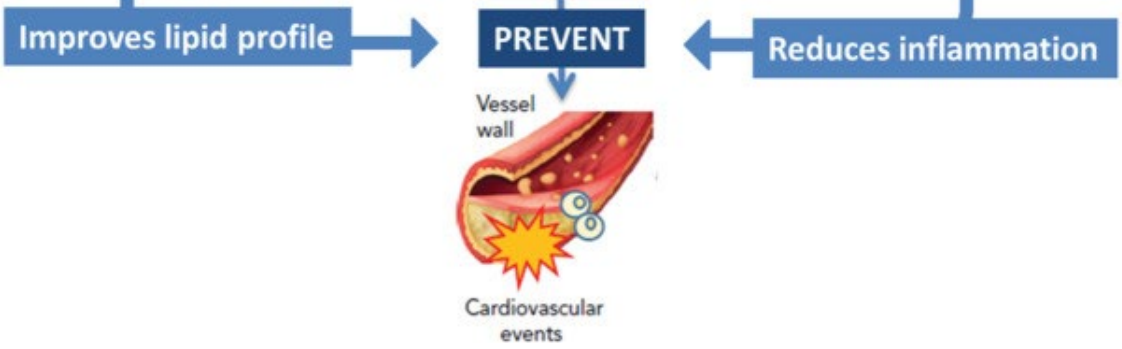
PERSONALIZED INTAKE OF



ACCORDING WITH INDIVIDUAL GENETICS:

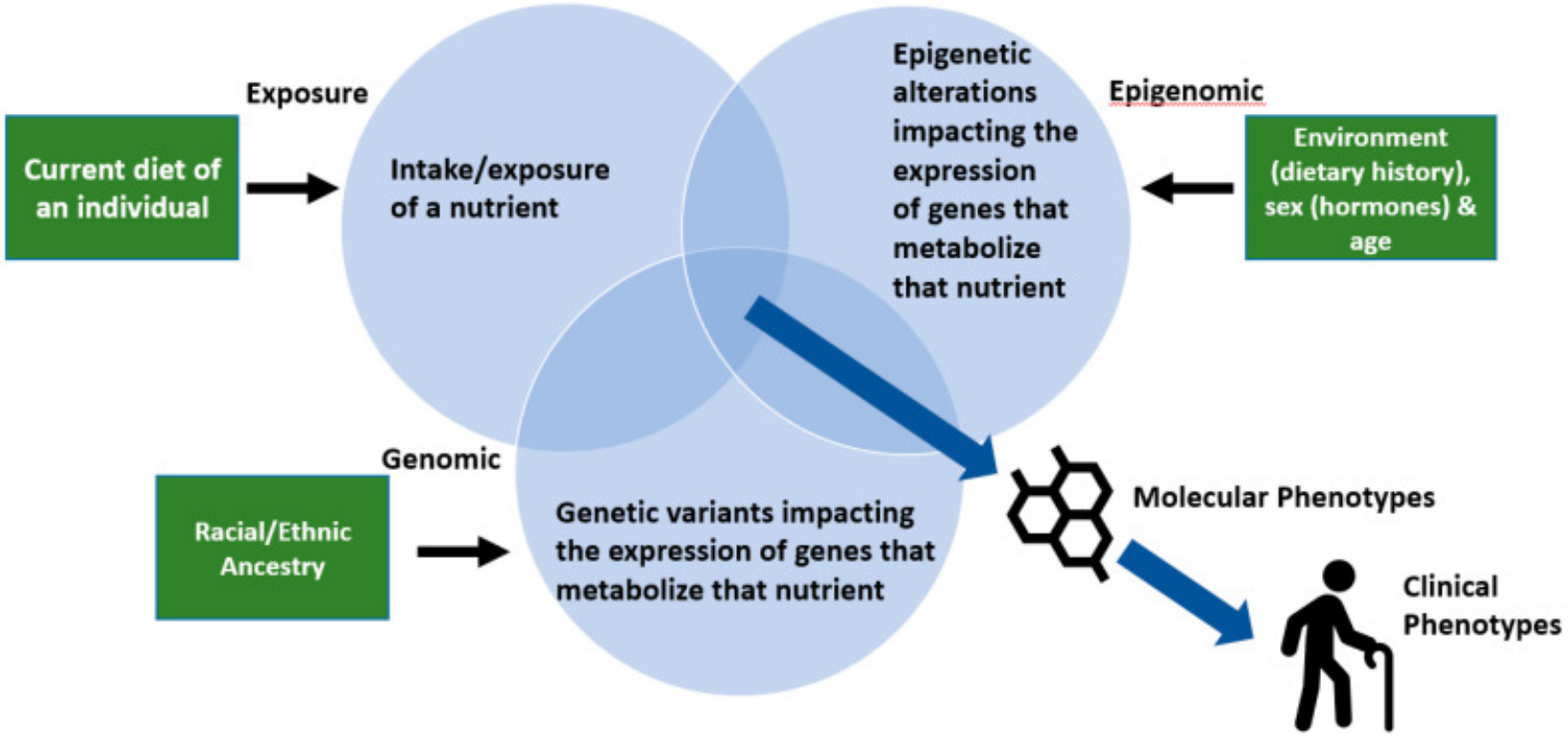
APOE | *FADS* | PPAR | MC4R | NPY | CLOCK | *MTHFR* | VDR | CYP1A2 | SNN1B | TRPV1

ALOX5 | *APOA* | FTO | CETP | MC3R | PON1 | ADRA2B | ADORA2A | SLC4A5



Barrea et al, Int J Obes Suppl. 2020 Jul; 10(1): 1–13

Anatomy of Gene-Diet Interactions



Mullins et al, Nutrients. 2020 Oct; 12(10): 3118.

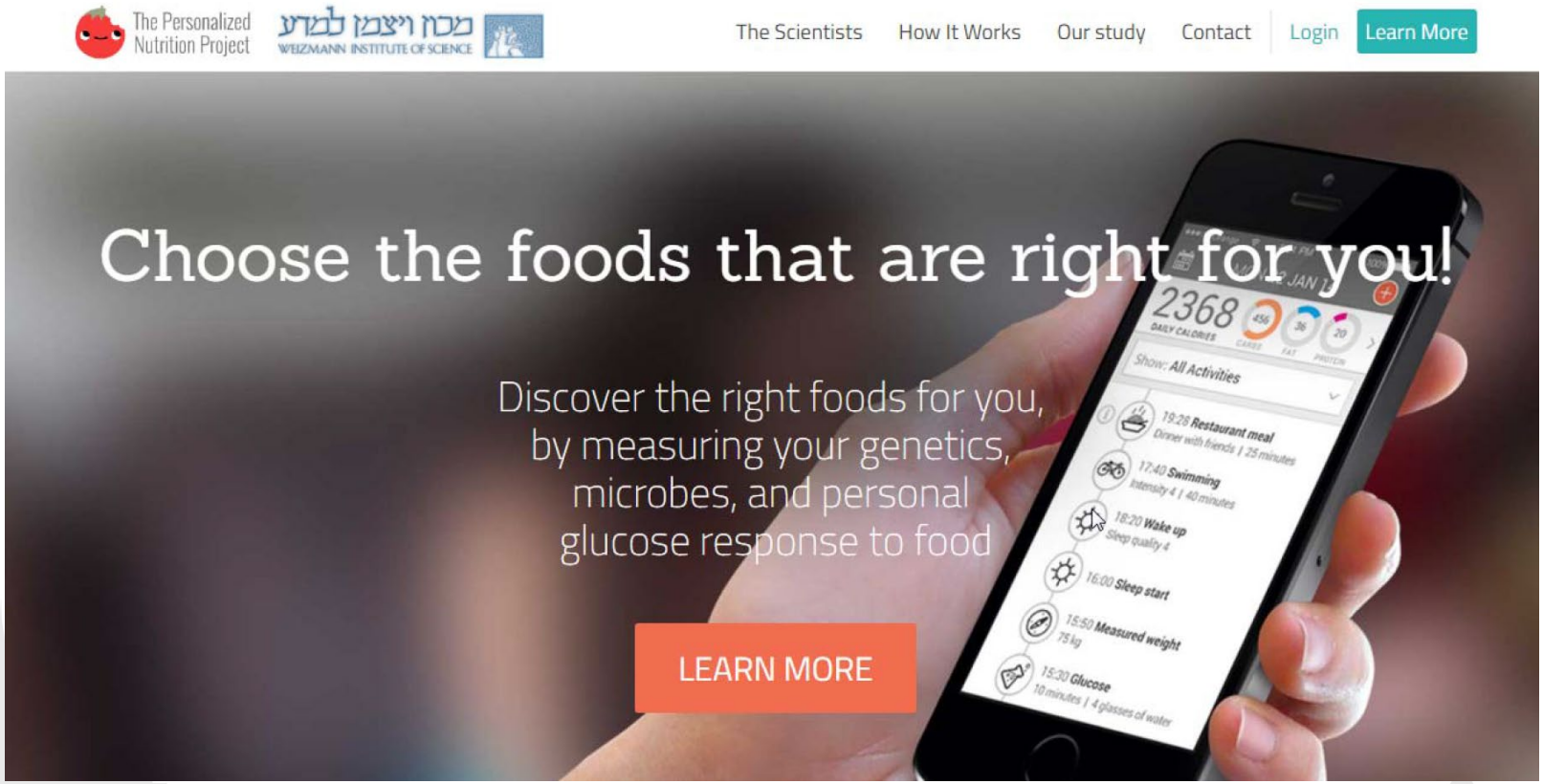
Table 2. Summary of examples of well-studied single nucleotide polymorphisms (SNPs) and their effects on nutrition and health.

Gene	SNP	Nutrition and Health Issue	Genotype Differences		
CYP1A2	rs762551	Caffeine Metabolism	C/C slow metabolizer	A/C slow metabolizer	A/A rapid metabolizer
ADH1B	rs1229984	Alcohol Metabolism	G/G	A/G Increased ETOH metabolism	A/A Increased ETOH metabolism
	rs2066702		G/G	A/G Increased ETOH metabolism	A/A Increased ETOH metabolism
PNPLA3	rs738409	Non-alcoholic fatty liver disease	C/C	G/C Increased fat accumulation	G/G Increase fat accumulation
FTO	rs9939609	Obesity and Appetite	T/T	A/T Increased adiposity	A/A Increased adiposity
APOE	rs7412	Cardiovascular and Alzheimer's Disease	T/T Lowest AD risk	C/T	C/C Increased AD risk
	rs429358		T/T Lowest AD risk	C/T	C/C Increased AD risk
MTHFR	rs1801133	Folate Metabolism	C/C	T/C Diminished enzyme activity	T/T Diminished enzyme activity
GC	rs7041	Vitamin D Transport	TT	TG	GG Lower Serum 25(OH)D
	rs4588		CC	C/A	AA Lower Serum 25(OH)D
FADS1	rs174537	Long-Chain Fatty Acid Biosynthesis	G/G Most efficient	T/G Varied efficiency	T/T Inefficient

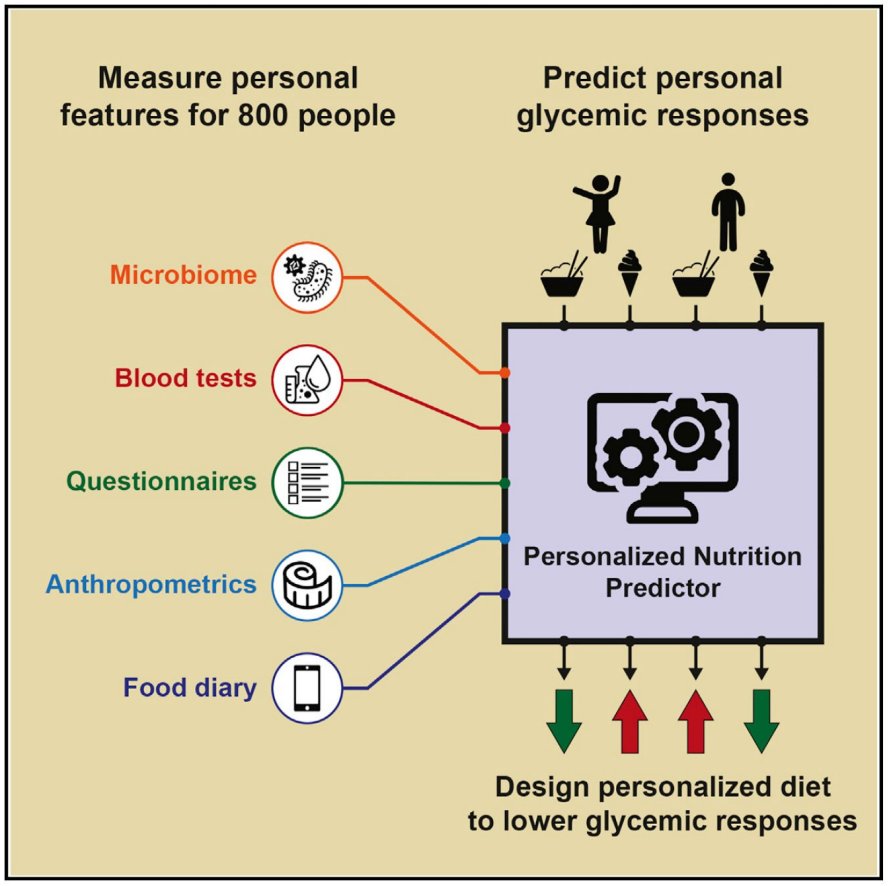
Cytocrome P450 1A2 (*CYP1A2*); alcohol dehydrogenase 1B (*ADH1B*); patatin-like phospholipase domain containing 3 (*PNPLA3*); fat mass and obesity-associated (*FTO*); apolipoprotein E (*APOE*); methylenetetrahydrofolate reductase (*MTHFR*); gc-globulin (*GC*); fatty acid desaturase (*FADS*).

Mullins et al, Nutrients. 2020 Oct; 12(10): 3118.

www.personalnutrition.org

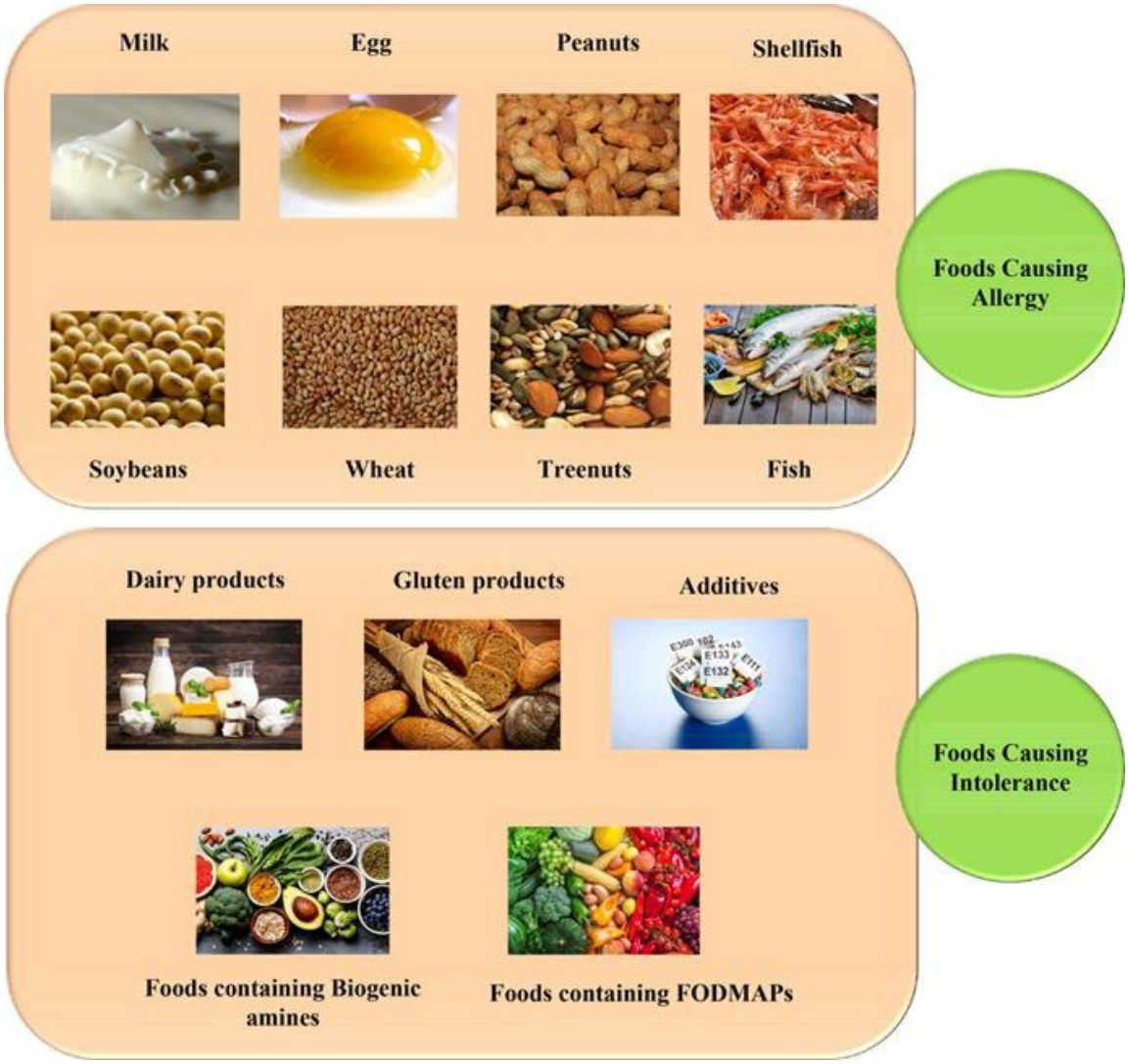


Personalized nutrition: novel perspectives



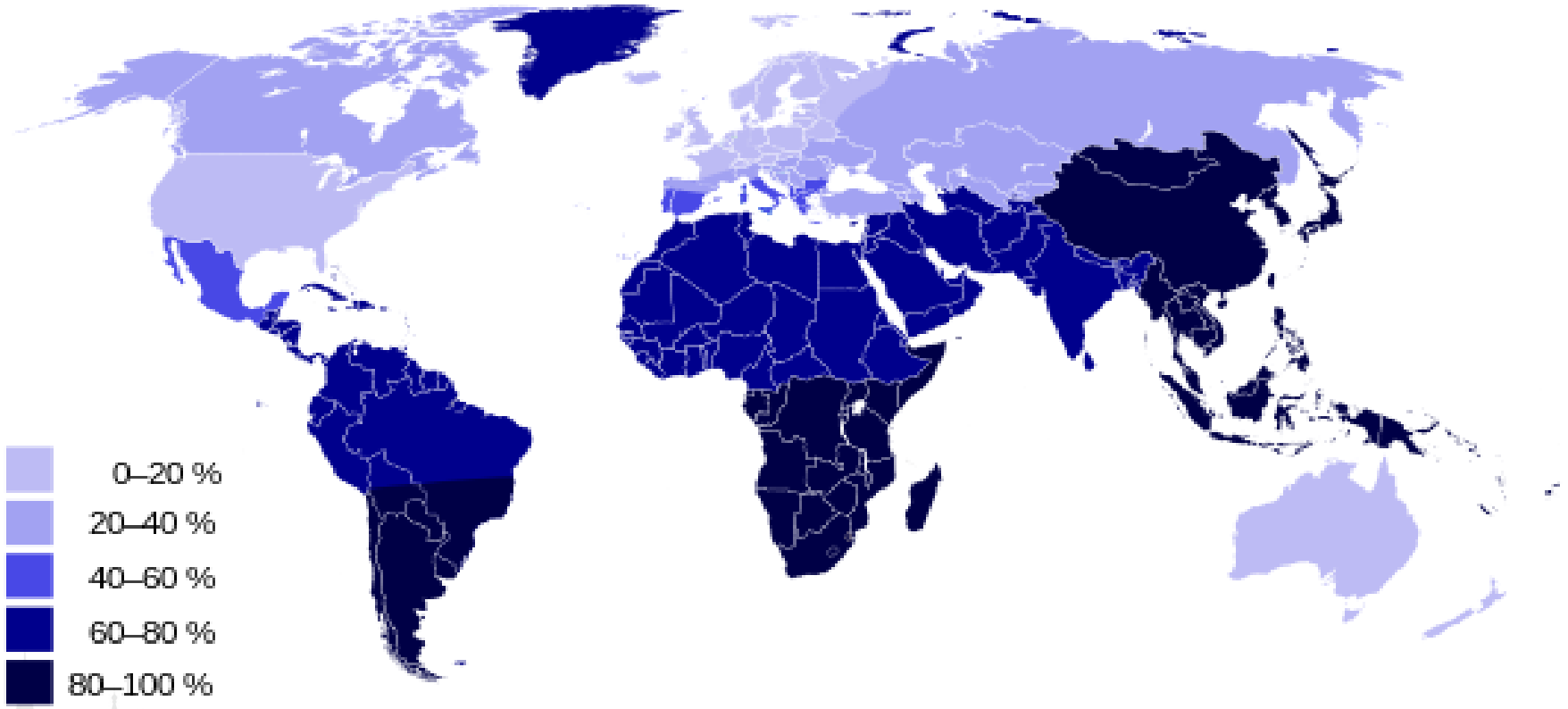
- High **interpersonal variability** in post-meal glucose.
- **Accurate prediction** of glucose response using personal and microbiome features.
- **Added value** compared to current practice.
- Successful ***short-term*** **personalized interventions.**

Zeevi et al, Cell 2015; 163: 1079



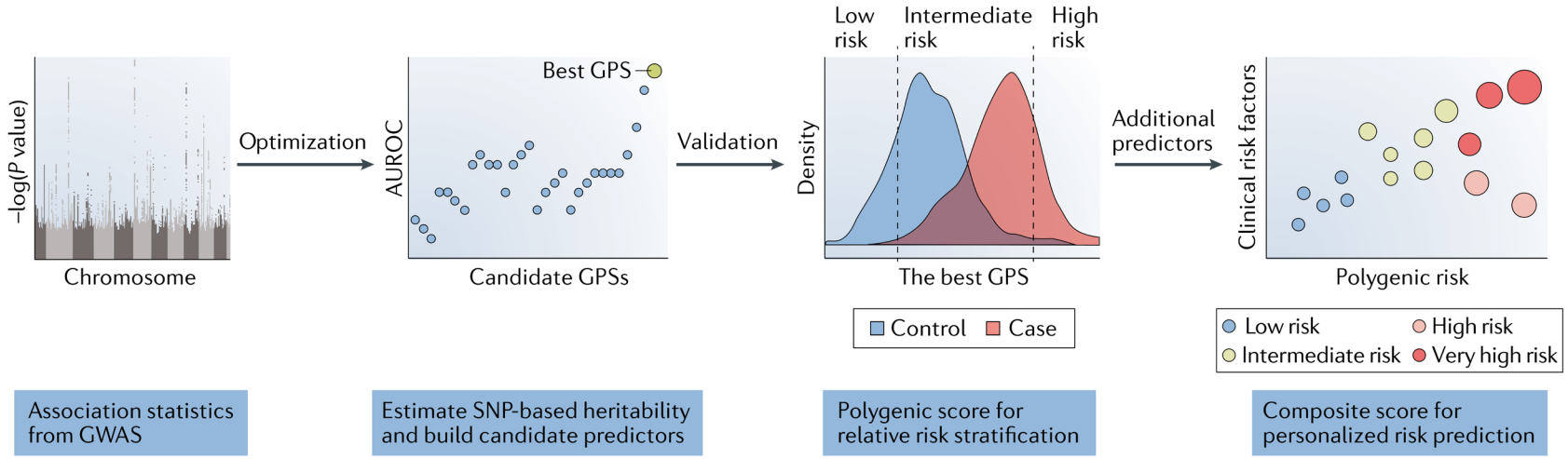
Muthukumar et al; Food Res Int 2020; 138: 109780; PMID: 33288166

Prevalence of lactose intolerance



http://goo.gl/RvorJ

Genome-wide polygenic risk score (GPS): principles



Liu & Kiryluk, Nat Rev Nephrol 2018

Use of polygenic risk scores for risk prediction

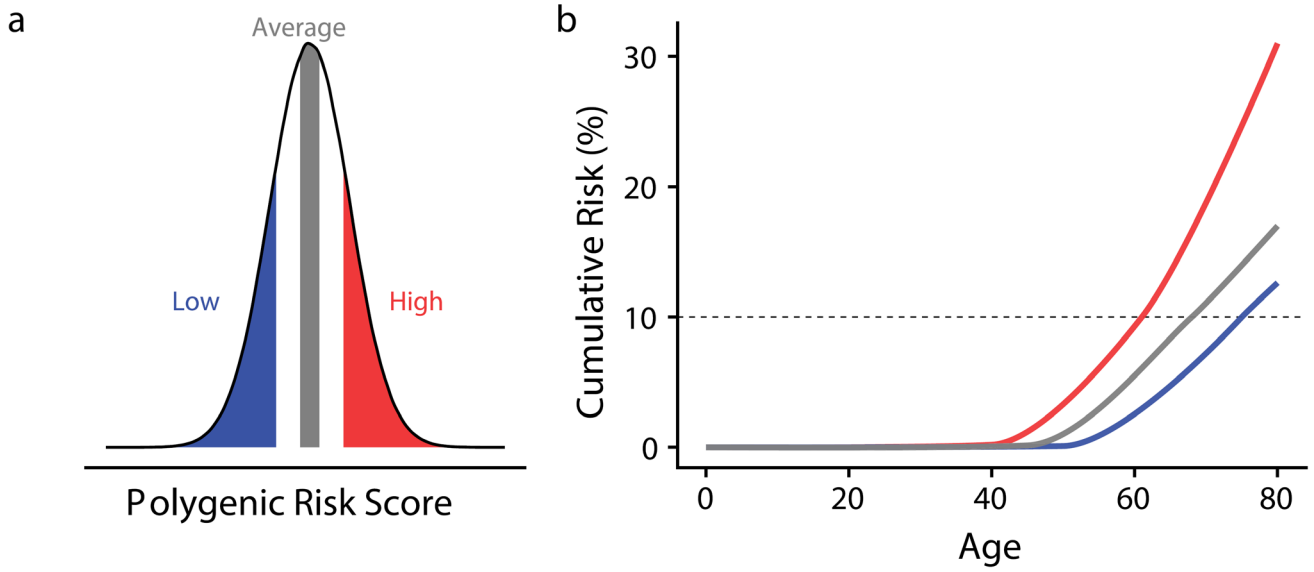
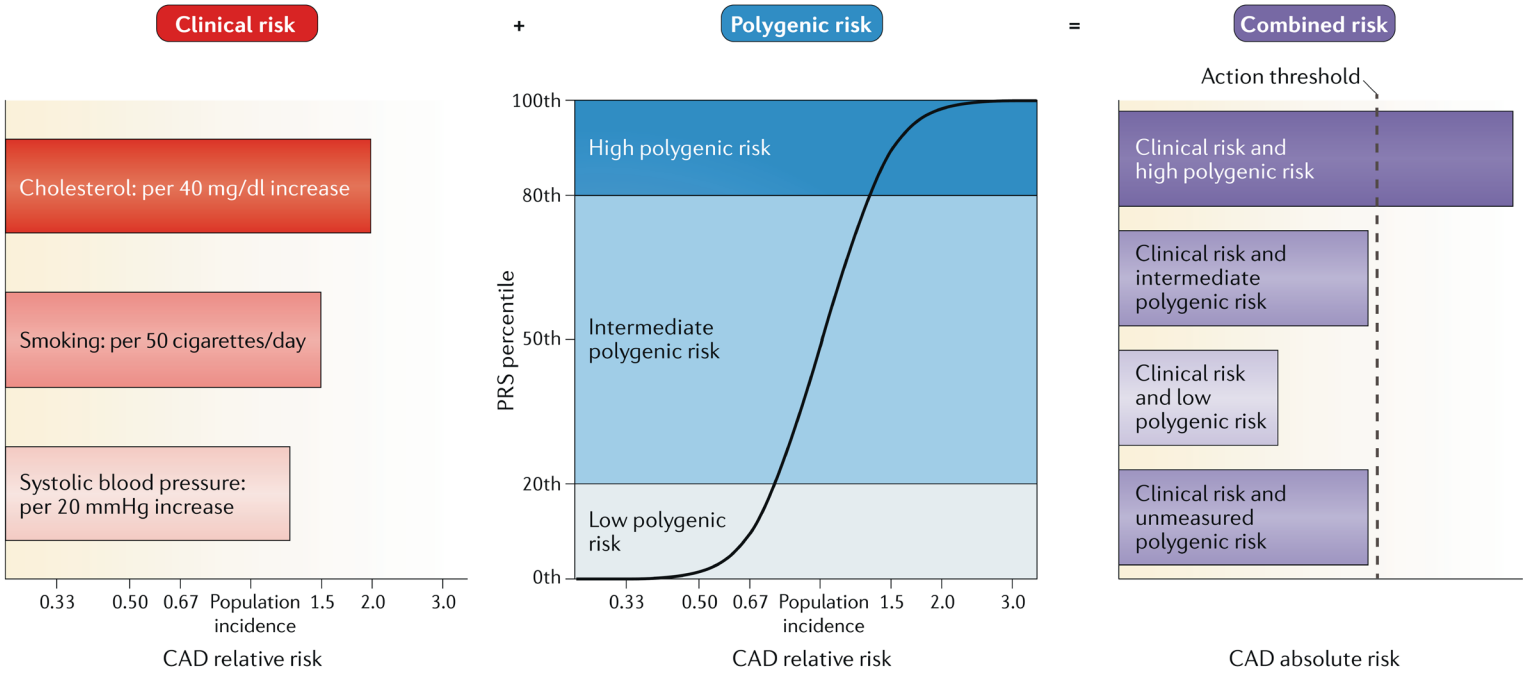


Figure 1. PRS define lifetime risk trajectories. (**a**) Example density plot of a population according to polygenic risk. The distribution is filled and labeled according to the lowest (0–20%; blue), population average (40–60%; grey) and highest (80–100%; red) quintiles of genetic risk. (**b**). Example of a risk trajectory (Kaplan–Meier cumulative risk curve) for the population average (grey) and the highest and lowest quintiles of genetic risk (colored as in a). Representative risk threshold is shown for example.

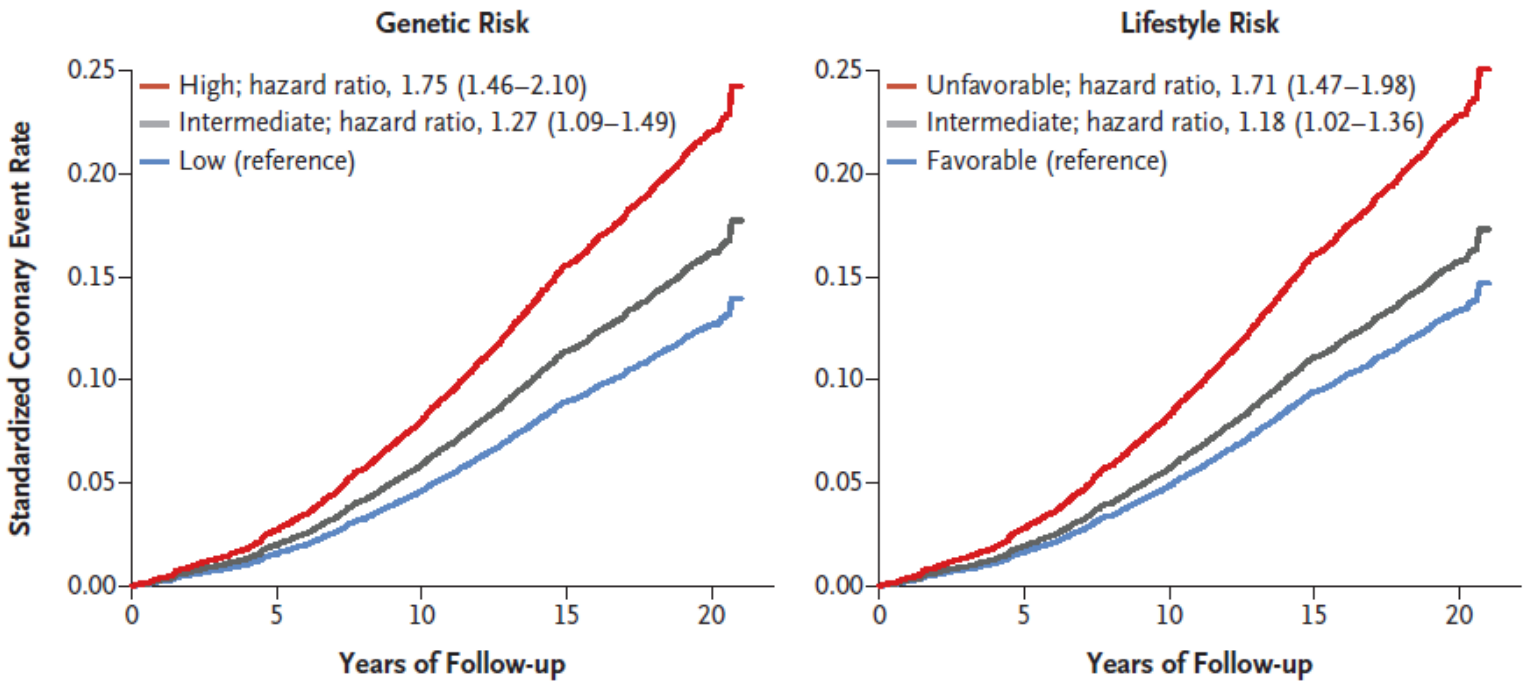
Lambert, Hum Mol Genet 2019. Towards clinical utility of polygenic risk scores

Clinical utility of polygenic risk scores



Torkamani et al, Nat Rev Genet 2018

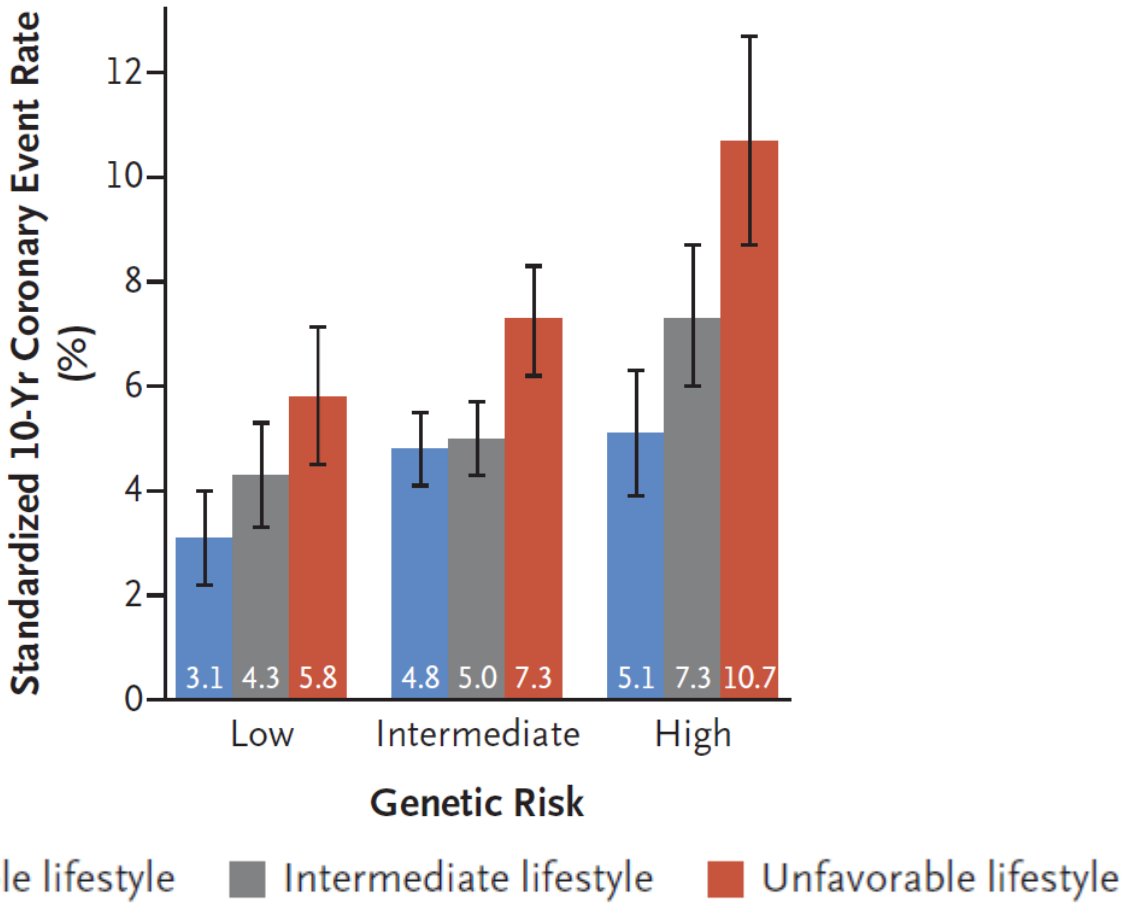
Risk prediction: comparison between genetic risk and lifestyle (tobacco, physical activity, nutrition)



USA. Age group: 45 to 64 years, starting in 1987. Genetic risk score based on 50 SNPs (variants).
Favorable lifestyle (≥ 3 out of 4 healthy lifestyle factors): no current smoking, no obesity, regular physical activity, and a healthy diet.
Intermediate lifestyle (2 healthy lifestyles).
Unfavorable lifestyle (≤ 1 healthy lifestyles).

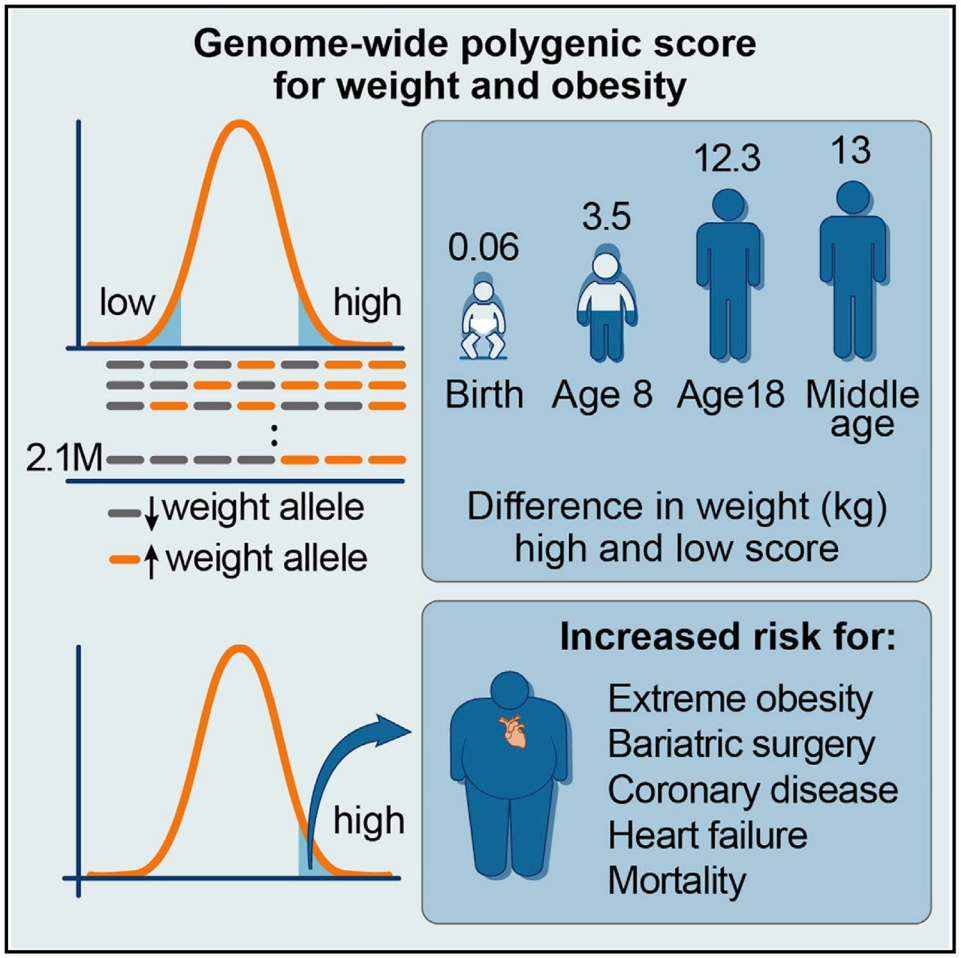
Khera et al, NEJM 2016

10-year risk of myocardial infarction using a genetic risk score



Khera et al, NEJM 2016

Obesity risk prediction at birth



- A genome-wide polygenic score (GPS) can quantify inherited susceptibility to obesity.
- Polygenic score effect on weight emerges early in life and increases into adulthood.
- Effect of polygenic score can be similar to a rare, monogenic obesity mutation.
- High polygenic score is a strong risk factor for severe obesity and associated diseases.
- The GPS is associated with only minimal differences in birthweight, but it predicts clear differences in weight during early childhood and profound differences in weight trajectory and risk of developing severe obesity in subsequent years.

Khera et al, Cell 2019 Apr 18;177(3):587-596.e9.

Polygenic scores, diet quality, and type 2 diabetes risk

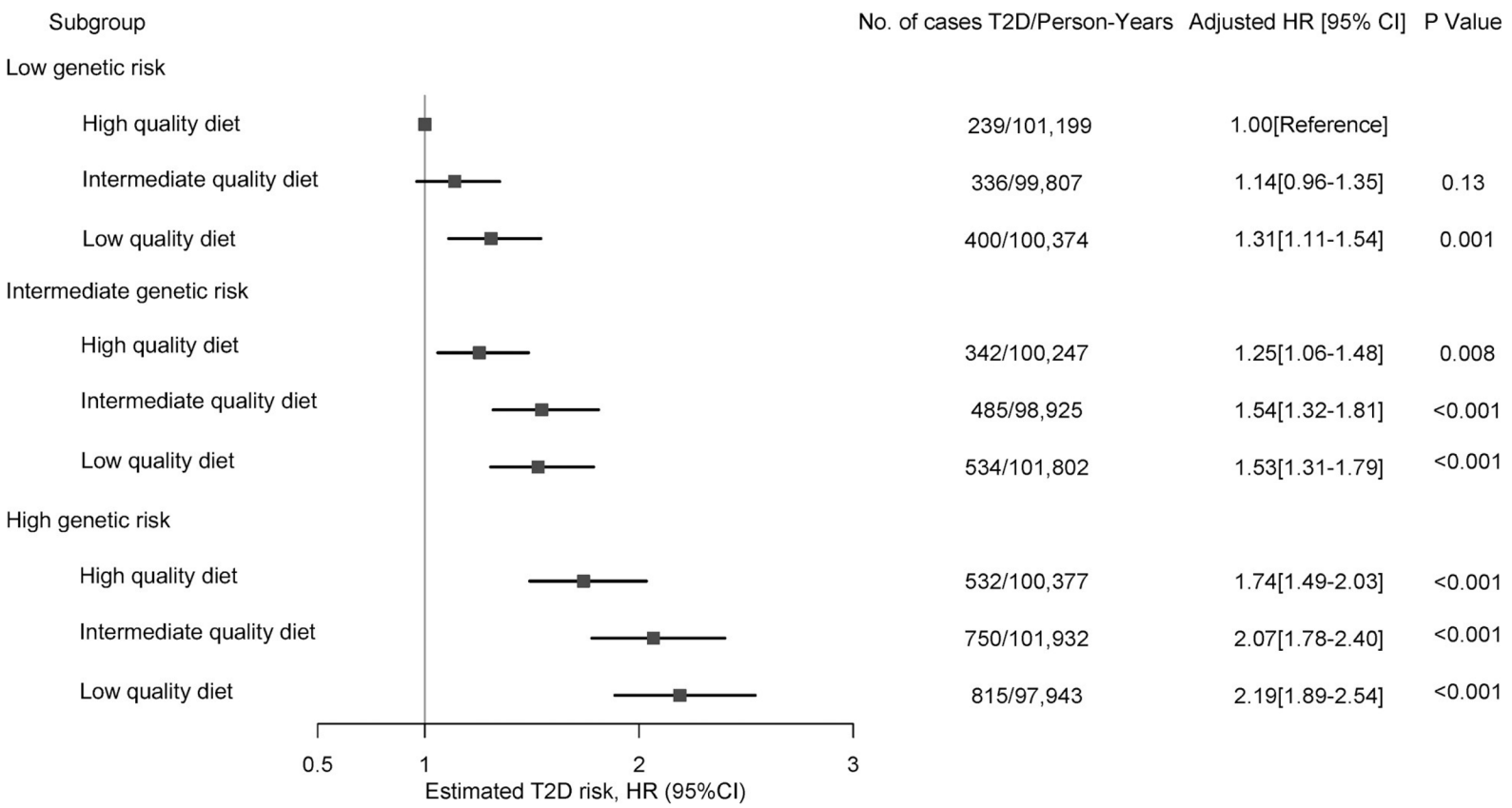
- Both genetic and lifestyle factors contribute to individual-level risk of type 2 diabetes.
- Understanding how genetic risk and diet quality contribute to the development of type 2 diabetes is important to support evidence-based preventive interventions.
- In 3 cohort studies involving **35'759 men and women in the US**, use of novel polygenic scores for type 2 diabetes.

➔ a healthier diet associated with lower risk of type 2 diabetes regardless of genetic risk.

➔ value of genetic risk for risk stratification and surveillance.

Merino Jordi et al. PLoS medicine 2022 19(4) e1003972

Relative risk of type 2 diabetes by genetic risk and diet quality



Shown are adjusted HRs and 95% CI of the estimate for type 2 diabetes in a pooled analysis of the 3 prospective cohorts according to categories of genetic risk and diet quality score. In these comparisons, participants with low genetic risk and high diet quality served as the reference group. Cox proportional hazards models were stratified by age and adjusted for ancestry-derived principal components, family history of diabetes, history of hypertension, history of hypercholesterolemia, menopausal status (women only), BMI, smoking status, physical activity, and total energy intake. Fixed-effects inverse variance weighted meta-analysis was used to combine cohort-specific results.

Merino Jordi et al. PLoS medicine 2022 19(4) e1003972

Personalized approach

CYP1A2, CYP2E1, CYP2D6; CYP3A2 ALDH2

PPARγ; APOE; 5-LO

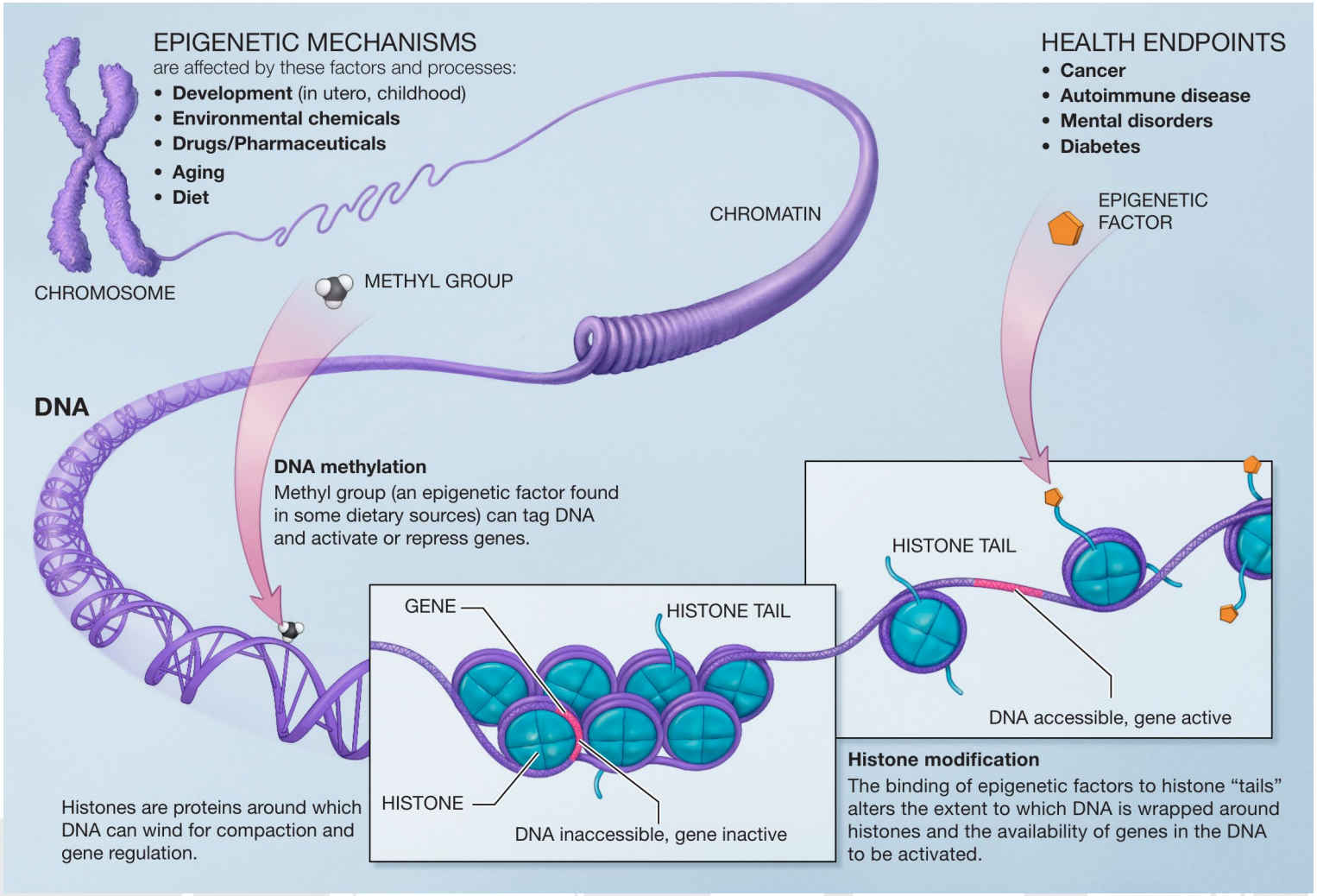
LCT; SLC2A9, ,VDR, CUB; CYPs, CASR

β3AR

TAS2R38; GSTM1/GSTT1

CYP1A2, CYP2C9, ADORA2A, AHR

Epigenetics



https://en.wikipedia.org/wiki/Epigenetics

Conclusions

- Diet is a major determinant of health and diseases (in particular cardiovascular disease, cancer and metabolic diseases).
- The production of foods for human diets has a substantial enviromental impact.
- Food choices are complex and influenced by a large number of individual-level, community-level and global level factors, including commercial ones.
- We are not all equal with respect to nutrition (dietary choices and their consequences on health).
- Part of these inter-individual differences are attributable to epi/genetic factors.
- This does not remove the importance of environmental factors and lifestyle!
- Current dietary/nutrition recommendations do not take genetic/epigenetic variants into account.

Perspectives

- Precision/personalized nutrition needs big data on a large number of people.
- The genome influences the way diet impacts on health and our diet influences the function of our genome mainly by epigenetic modifications.
- New technologies (« omics fields ») will allow improving our understanding of how genomic information influences human health.
- Novel analytic methods need to be developped to better take complex physiological mechanisms into account.
- Large scale population-based cohorts with long-term follow-up will play a key role in knowledge generation in nutrigenomics and will provide tools for monitoring and interventions.