Rationale for Precision Nutrition

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National Institutes of Health

Outline

Precision nutrition approaches are needed

Precision nutrition is possible

Precision nutrition is happening

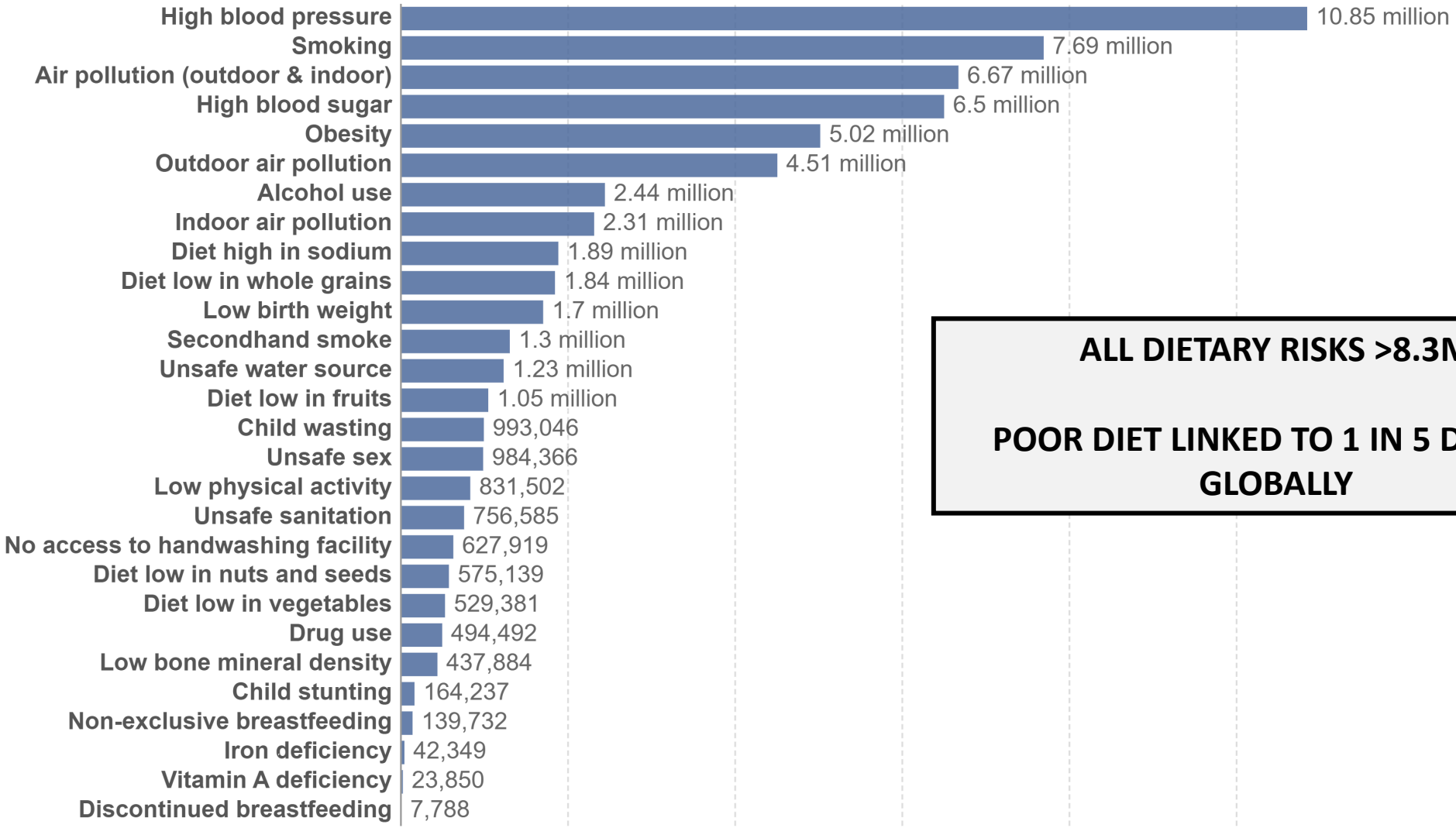
Precision nutrition is public health nutrition

Precision nutrition definition

- An important constituent of precision medicine: prevention and treatment strategies that take individual variability into account
- “Precision Nutrition in research and practice considers multiple, synergistic levels of influence: dietary habits, genetic background, health status, microbiome, metabolism, food environment, physical activity, socioeconomics, psychosocial characteristics, and environmental exposures.” – Francis Collins, 2020-2030 Strategic Plan for NIH Nutrition Research

A New Initiative on Precision Medicine | NEJM

Poor diet impacts disease mortality



ALL DIETARY RISKS >8.3M

POOR DIET LINKED TO 1 IN 5 DEATHS GLOBALLY

THE INSTITUTE FOR HEALTH METRICS AND EVALUATION, Global Burden of Disease (2019)

Nutrition-related health conditions in the US

- **74%** of US adults have overweight or obesity
- Overweight and obesity affects about **40%** of children

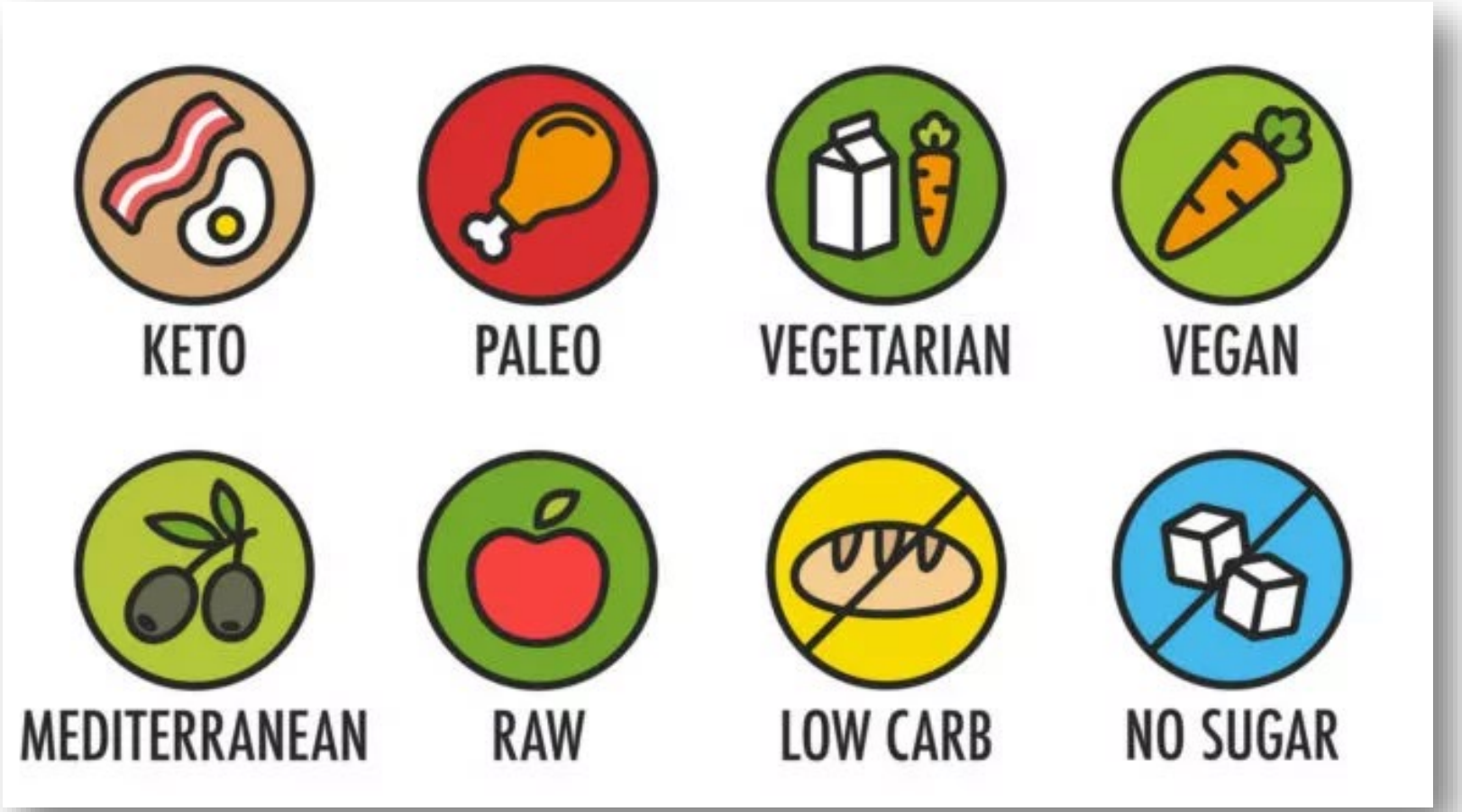
- Is the leading cause of death
- High blood pressure
- High cholesterol

- **11%** of US adults have diabetes
- **35%** have prediabetes
- **210,000** children and adolescents have diabetes

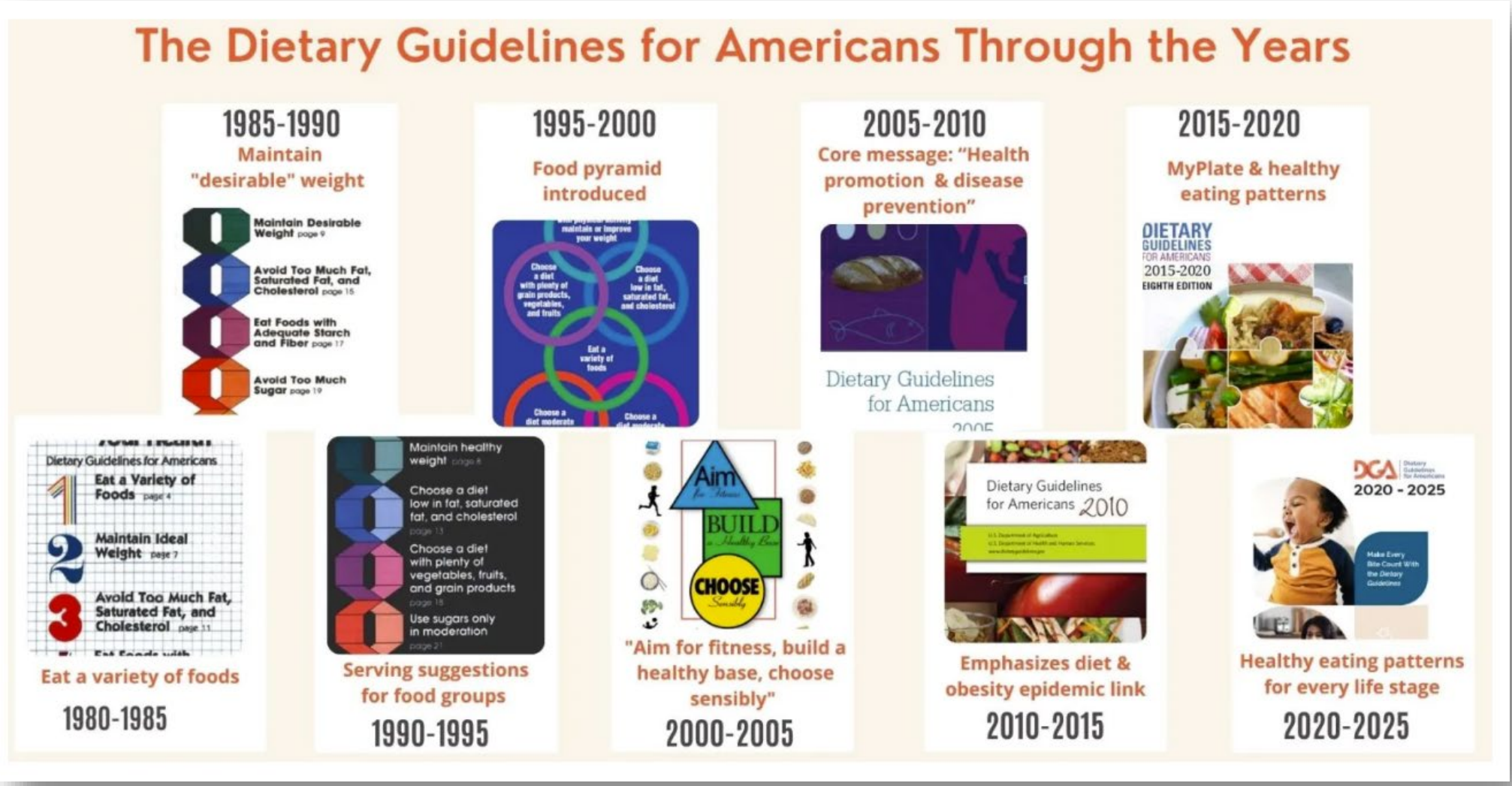
- Breast cancer
- Colorectal cancer

Food is at the epicenter of health and disease. But clinical nutrition is still limited to a one-size-fits most approach.

Unlimited number of diets

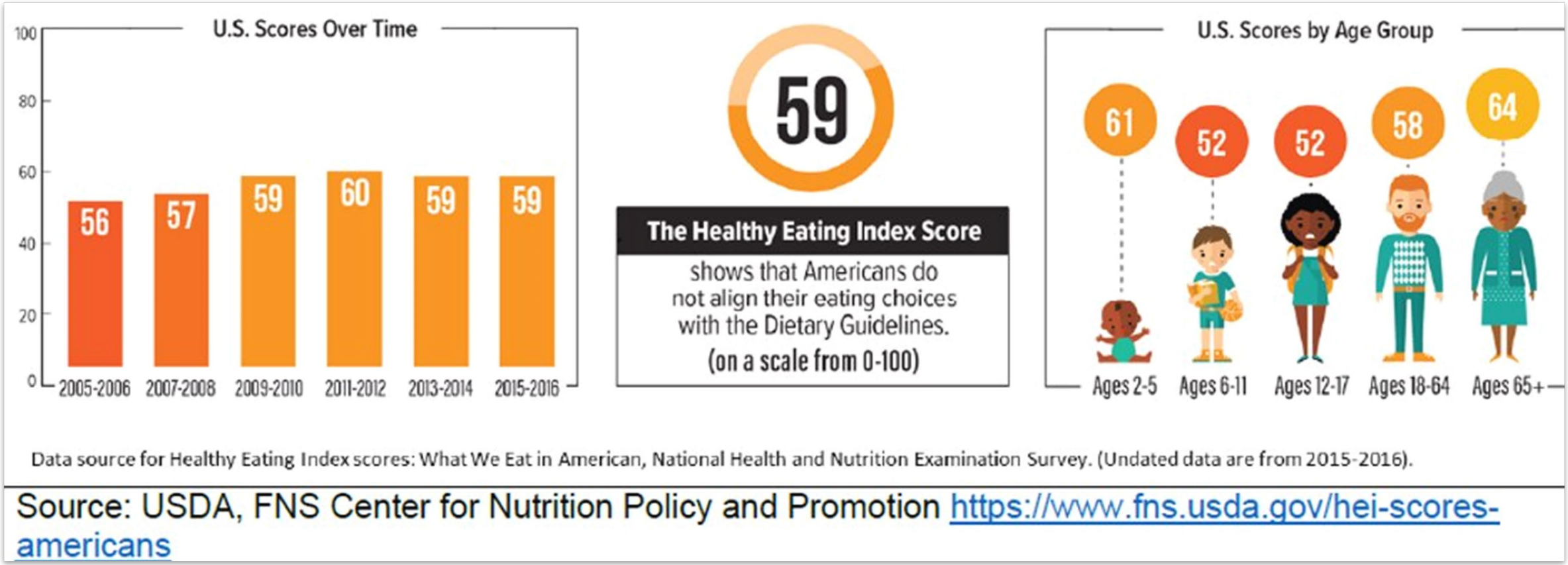


US Dietary Guidelines



Source: https://bwhheartandscience.org/2021/03/18/dietary-guidelines/

American diets are not aligned with the Dietary Guidelines



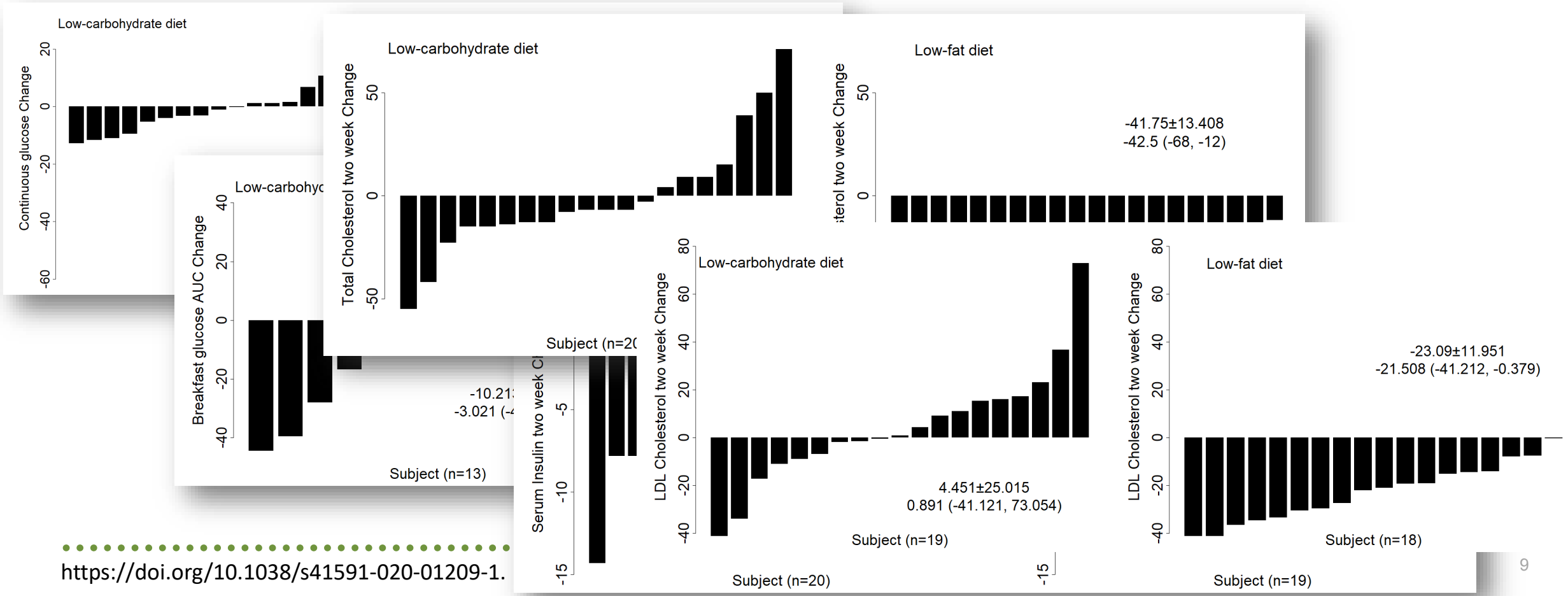
Data source for Healthy Eating Index scores: What We Eat in American, National Health and Nutrition Examination Survey. (Undated data are from 2015-2016).

Source: USDA, FNS Center for Nutrition Policy and Promotion https://www.fns.usda.gov/hei-scores-americans

This is not an issue with dietary adherence

Effect of a plant-based, low-fat diet versus an animal-based, ketogenic diet on ad libitum energy intake

nature medicine



https://doi.org/10.1038/s41591-020-01209-1.

DASH Eating Plan

- Vegetables (fresh or frozen)
  4–5 servings daily
- Fruits (whole fruits)
  4–5 servings daily
- Low fat or nonfat dairy foods
  2–3 servings daily
- Meats, poultry, and fish
  2 or less servings daily
- Grains and grain products
  7–8 servings daily
- Nuts, seeds, and legumes
  4–5 servings per week
- Control sodium intake (~2300 mg/day

DASH Diet

DASH Diet is ranked*

- **#2** in **Best Heart-healthy Diets**
- **#2** in **Best Diabetes Diets**
- **#2** in **Best Diets for Bone and Joint Health**
- **#3** in **Best Diets for Healthy Eating**
- **#2** in **Best Diets Overall**
- **#5** in **Best Weight-loss Diets**
- **#3** in **Easiest Diets to Follow**
- **#3** in **Best Family Friendly Diets**

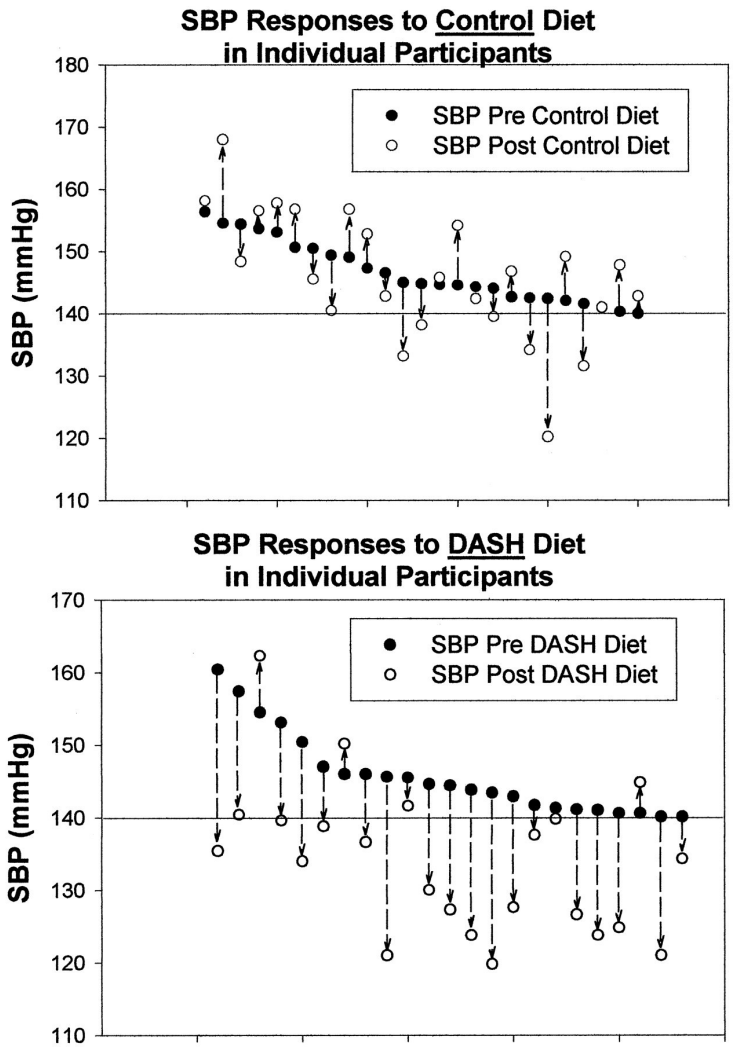
* 43 nationally recognized expert panelists scored diets in 11 categories from 5 (highest) to 1(lowest), which included best overall, diabetes, heart disease prevention, ease of compliance, nutritional completeness, and health risks.

https://health.usnews.com/best-diet/dash-diet. Accessed 1/4/2024

Benefits of DASH

- **Lowers blood pressure** more effectively than the other diets
- Drop in blood pressure in people who had hypertension was **equal to that found with medications**
- Effective in **all groups of people studied** (men, women, Black, white, people with normal and high blood pressure)
- **Lowered total cholesterol and LDL cholesterol** (bad cholesterol) compared those on a regular diet
- DASH diet **did not increase triglycerides** even though carbohydrates were increased

Interindividual variability



Hypertension

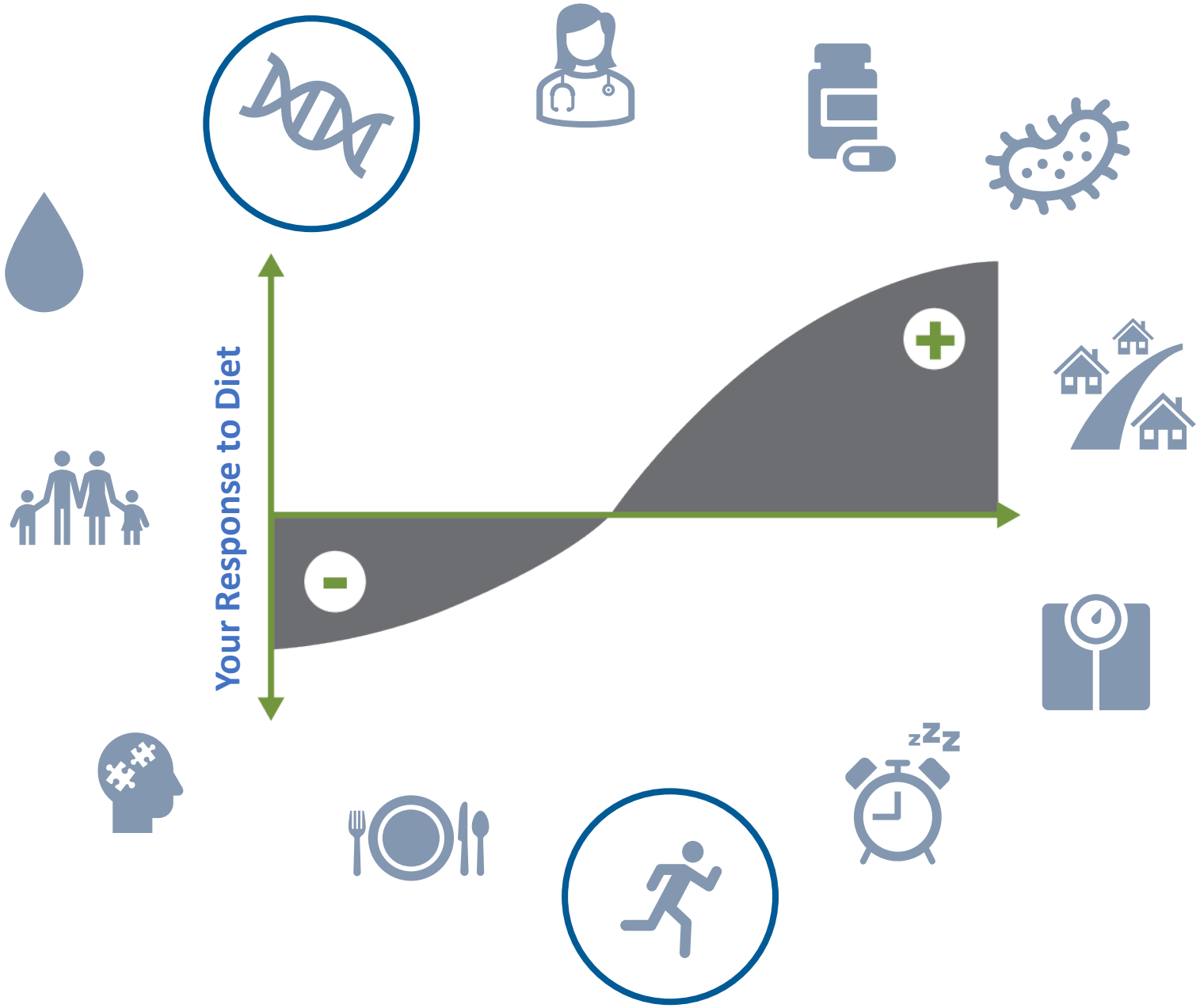
DASH (Dietary Approaches to Stop Hypertension) Diet Is Effective Treatment for Stage 1 Isolated Systolic Hypertension

Thomas J. Moore, Paul R. Conlin, Jamy Ard, Laura P. Svetkey and for the DASH Collaborative Research Group

Originally published 1 Aug 2001 | https://doi.org/10.1161/01.HYP.38.2.155 | Hypertension. 2001;38:155–158

confidence interval, -2.5 to -13.4 mm Hg; P<0.01). Overall, blood pressure in the DASH group fell from 146/85 to 134/82 mm Hg. Similar results were observed with 24-hour ambulatory blood pressure measurements. In the DASH diet group, 18 of 23 participants (78%) reduced their systolic blood pressure to <140 mm Hg, compared with 24% and 50% in the control and fruits/vegetables groups, respectively. Our results indicate that the DASH diet, which is rich in fruits, vegetables, and low-fat dairy foods, is effective as first-line therapy in stage 1 ISH.

Diets do not affect everyone the same



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Personalized Nutrition by Prediction of Glycemic Responses

David Zeevi,[1,2,8] Tal Korem,[1,2,8]
Orly Ben-Yacov,[1,2] Dar Lador,[1,2]
Elad Matot,[1,2] Gal Malka,[1,2] Noa
Meirav Pevsner-Fischer,[3] Rony

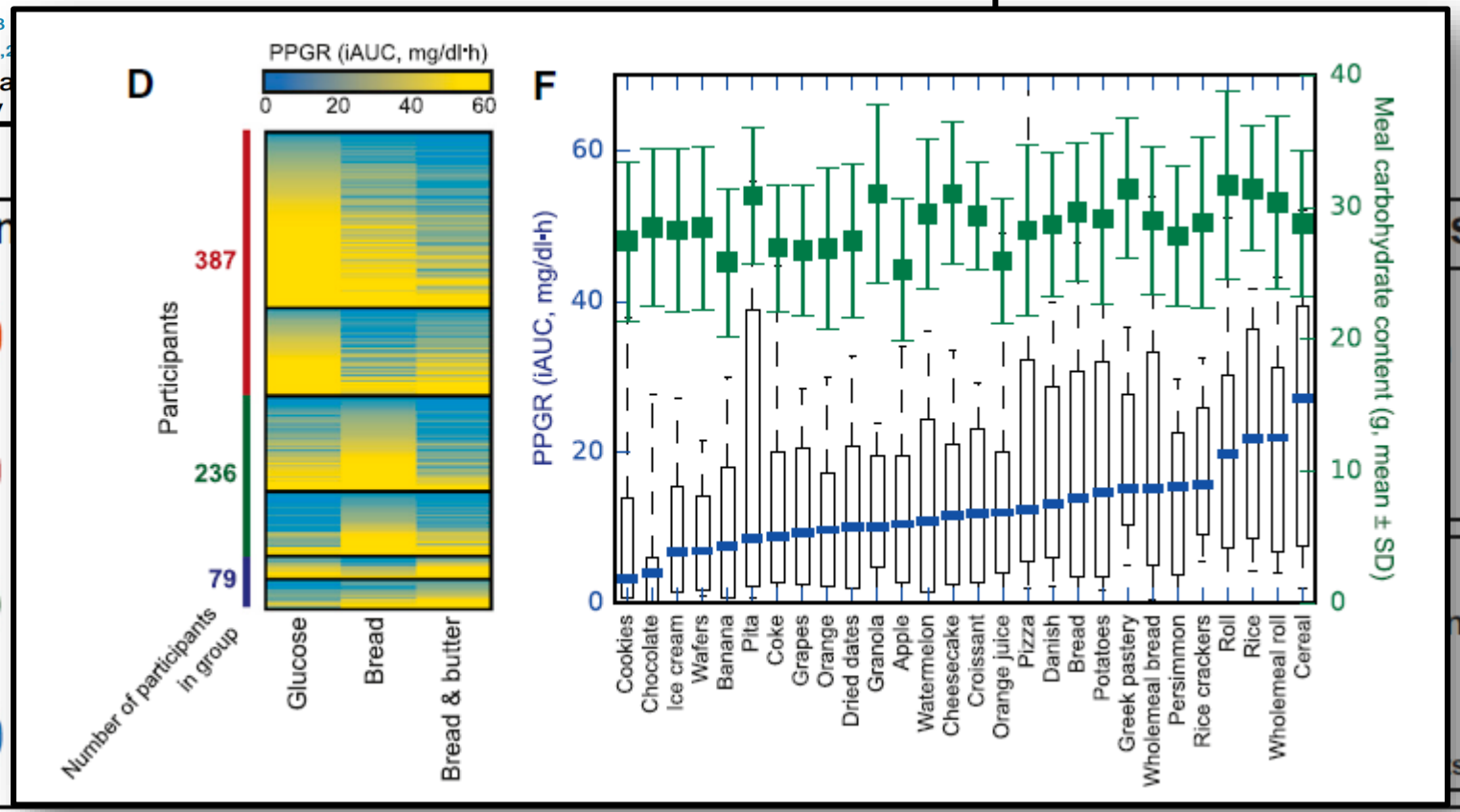
Per person profilin

Gut microbiome
16S rRNA
Metagenomics

Blood tests

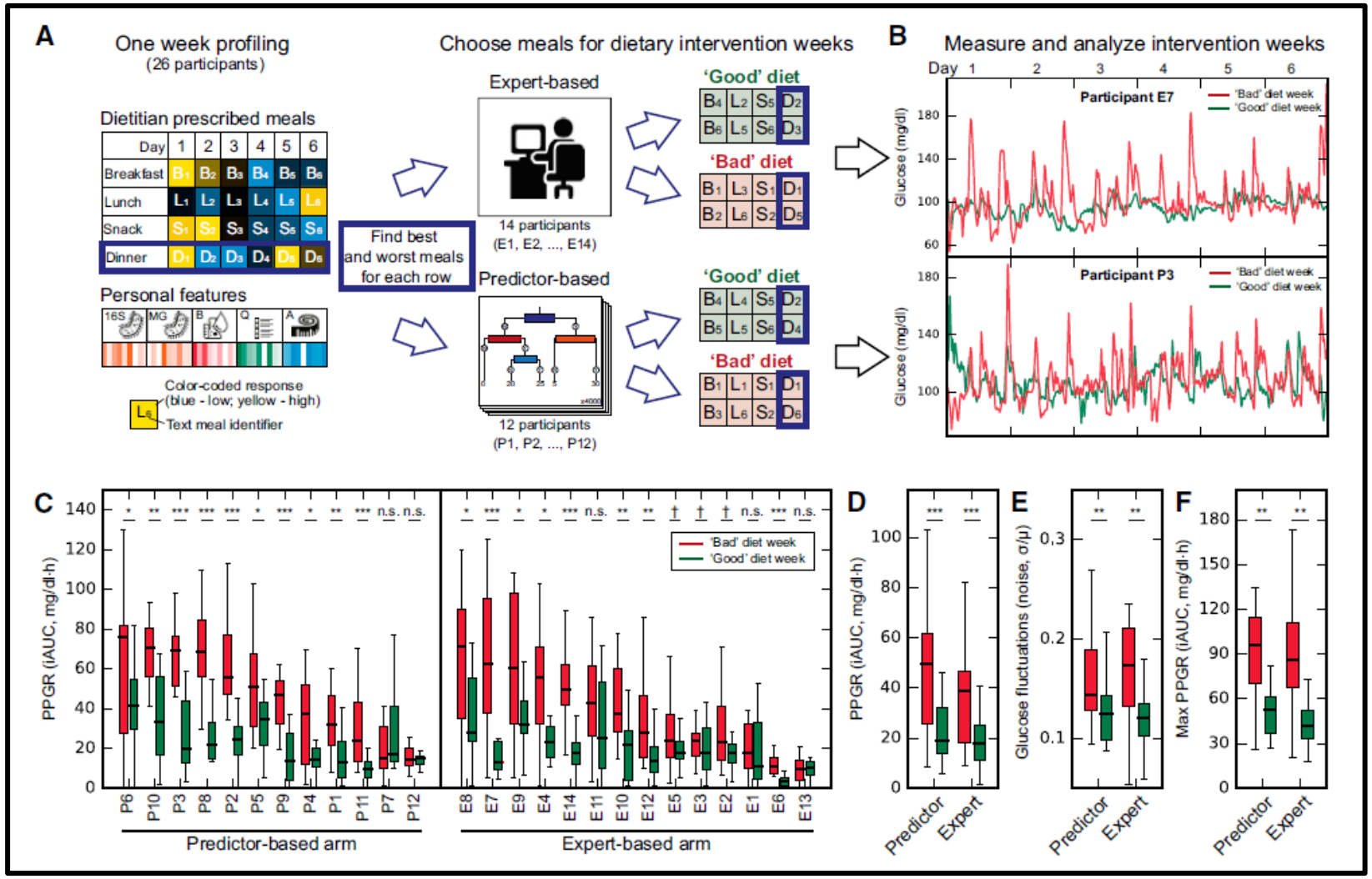
Questionnaires
Food frequency
Lifestyle
Medical

Anthropometrics



Zeevi et al., *Cell* 163:1079-1094 **2015**

AI and ML could predict postprandial glucose response



Zeevi et al., *Cell* 163:1079-1094 **2015**

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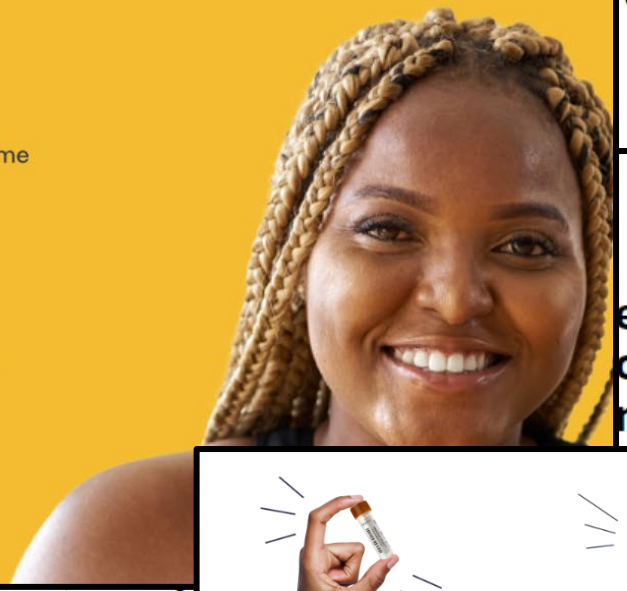
Understand how food affects *your body*.

Get started →

Gut microbiome
Good

Blood fat
Excellent

Blood sugar
Good



nature medicine

e-scale high-resolution studies are lacking. We o the PREDICT 1 study and assessed postpran- nter-individual variability (as measured by the

15.4%, respectively); genetic variants had a modest impa C-peptide). Findings were independently validated in a U that predicted both triglyceride ($r = 0.47$) and glycemic (r for developing personalized diet strategies. The ClinicalTr

Complete your tests

Easy, at-home tests give us an inside look at your blood fat, blood sugar, and gut microbiome health.

Get your ZOE Scores

Using your results, we score every food (from 0-100), so you can make better choices of what to eat.

Build new habits

We teach you how to swap, add and combine foods so you can eat in the best way for your body.

Boost your health

Feel more energised and improve your long-term health while eating more of the foods you love.

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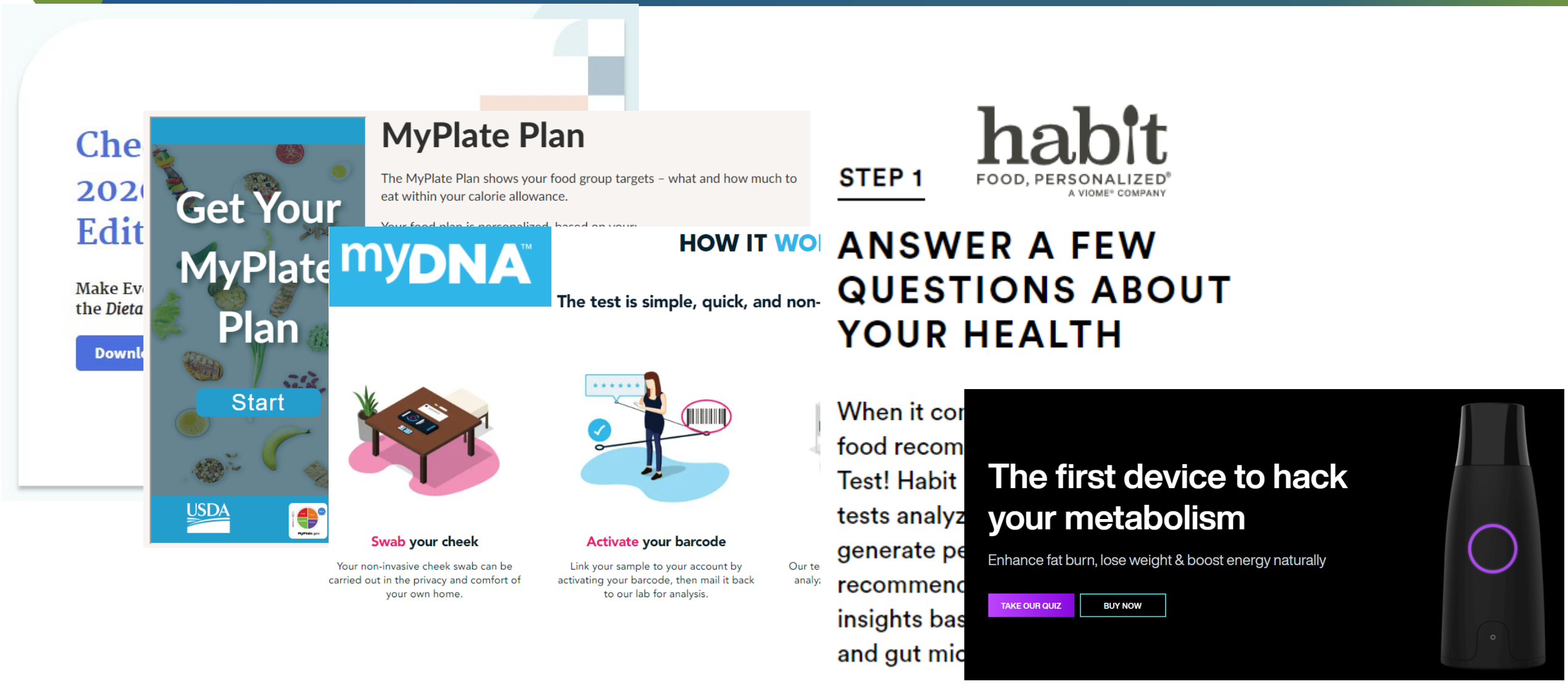


Scientific need for precision nutrition approaches

How do we get the science to catch up to the need?

- Research on more diverse populations
- More research on uncovering the factors underlying interindividual variability
- Better understanding of the interactions between these factors
- More precise dietary assessment methodologies
- Identification of chronic disease biomarkers to identify diet-chronic disease links faster
- More targeted algorithms for dietary guidance

Strategic Plan for NIH Nutrition Research

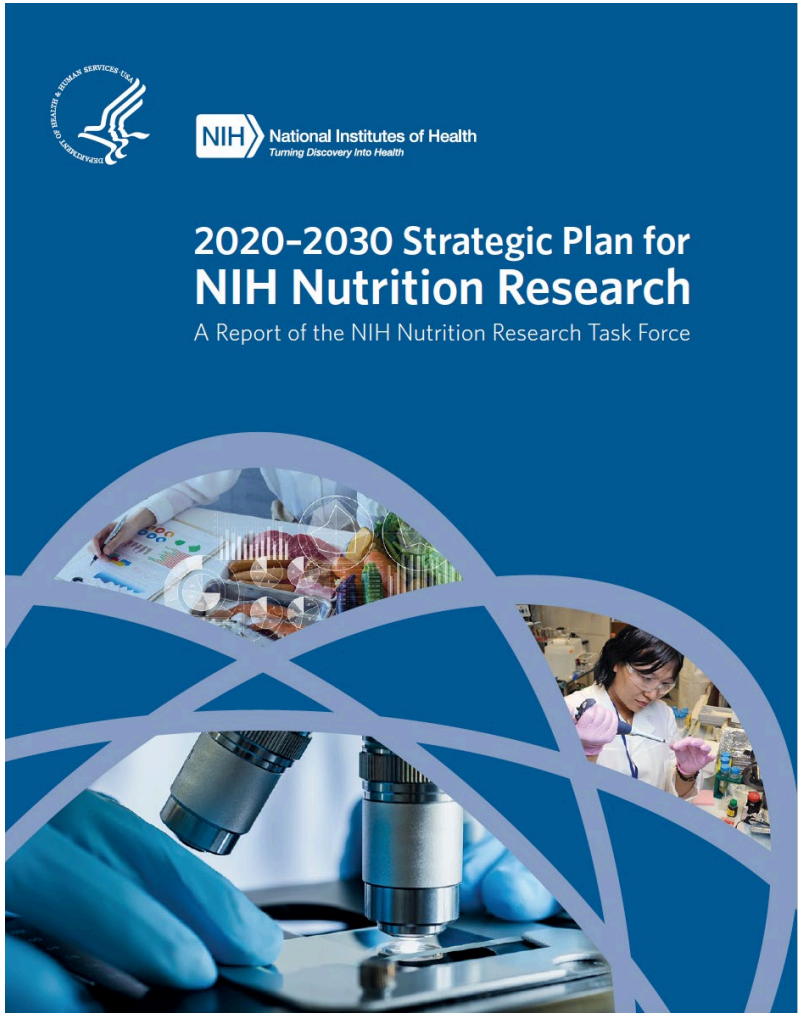
Unifying Vision:
Precision Nutrition

1 Spur Discovery and Innovation through Foundational Research—*What do we eat and how does it affect us?*

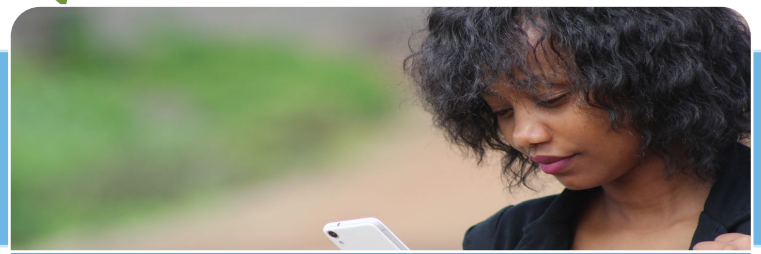
2 Investigate the Role of Dietary Patterns and Behaviors for Optimal Health—*What and when should we eat?*

3 Define the Role of Nutrition Across the Lifespan—*How does what we eat promote health across our lifespan?*

4 Reduce the Burden of Disease in Clinical Settings—*How can we improve the use of food as medicine?*



Nutrition for Precision Health, powered by the *All of Us* Research Program



Examine baseline diet and physiological responses to meal challenges

10,000 *All of Us* participants

Examine responses to 3 short-term intervention diets in community dwelling controlled feeding studies

1,500 Module 1 participants

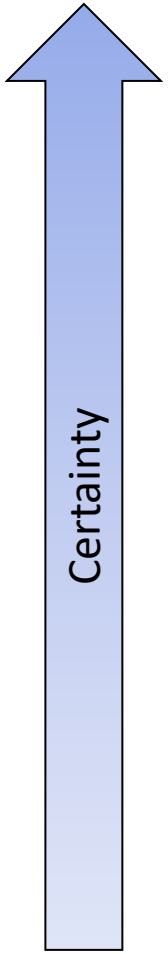
Examine responses to 3 short-term intervention diets in domiciled controlled feeding studies

500 Module 1 participants

In all 3 modules

- Collect microbiome, physiological, metabolic, behavioral, cognitive, and environmental data, and leverage existing genomic, EHR, and survey data, and conduct mixed meal challenges to model the impact of diet and dietary patterns on physiological responses
- Use machine learning and artificial intelligence to develop predictive algorithms

Potential next steps after NPH



- Broad sharing of NPH findings
- Validation of algorithms
  - Can targeted dietary guidance based on NPH algorithms produce desired health results?
- Consideration of NPH findings for public health dietary guidelines
- Incorporation of NPH findings into clinical practice
  - Additional questions at intake
  - Additional lab tests

How can NPH results/evidence be used?

- Algorithm validation
- Hypothesis generation
- Targeted follow up studies

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Implementation of precision nutrition in the clinic

- Currently, RDNs and other professionals consider
  - Patient demographics
  - Medical history
  - Goals
  - Patient preferences and abilities
  - Potential for adherence
  - Much more
- Will addition of more personalized/precision factors:
  - Better help patients get the desired health response?
  - Be more burdensome for the practitioner and/or patient?
  - Help the patient feel more empowered to follow advice/dietary plans?

Implementation of precision nutrition in public health guidance

- Currently, DGAs consider age, sex, weight, dietary preferences, culture, and budget
- IF newly identified predictors may account for more interindividual variability, they could be additional factors for personalization

How can precision nutrition benefit everyone?

- Build a strong evidence base by studying a broad set of potential predictors in a large and diverse population
  - Demographic
  - Health status
  - Access to care
- Consider predictors that are easy, simple, or inexpensive to measure
  - Questionnaires
  - Point-of care technologies
- Goal to optimize health

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