

Individuals in Context

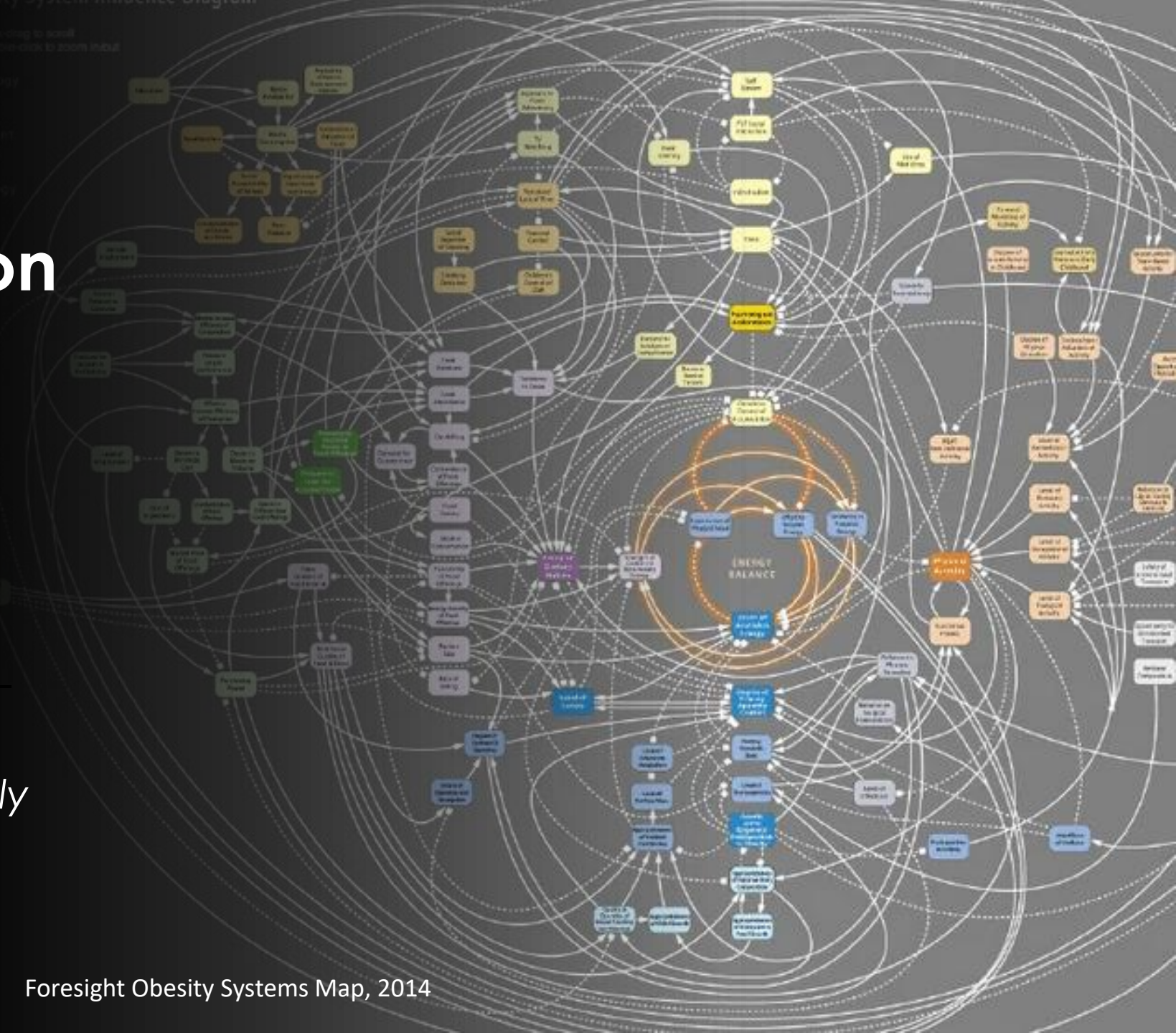
Innovative Data and Analytics to Understand the Systems Shaping Obesity

Dr. Kayla de la Haye

Obesity prevention requires systemic (vs. individual) strategies

Dozens of interacting factors, spanning genes, behaviors, environments, and policies, shape obesity risk.

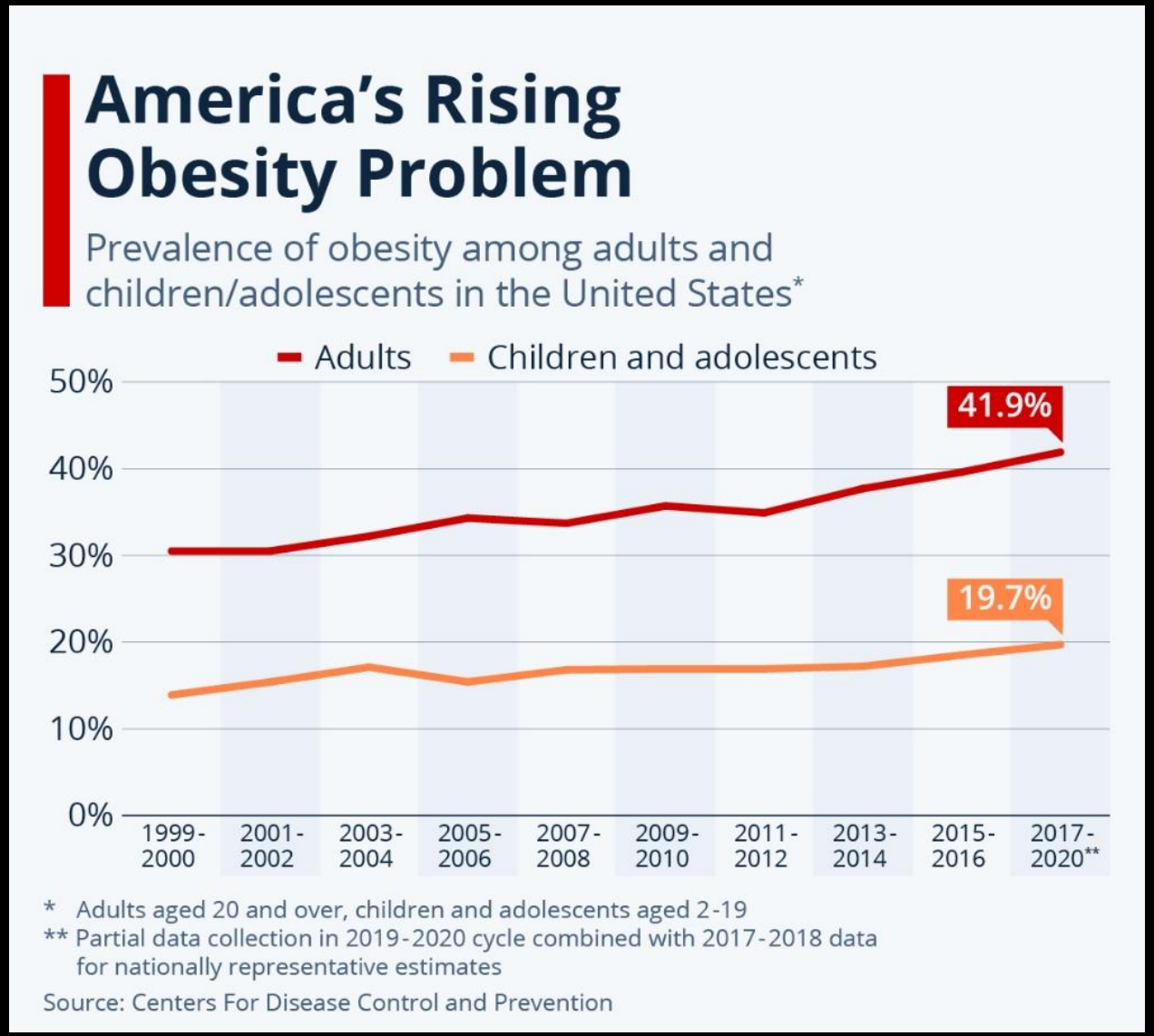
Targeting one in isolation rarely shifts the whole.



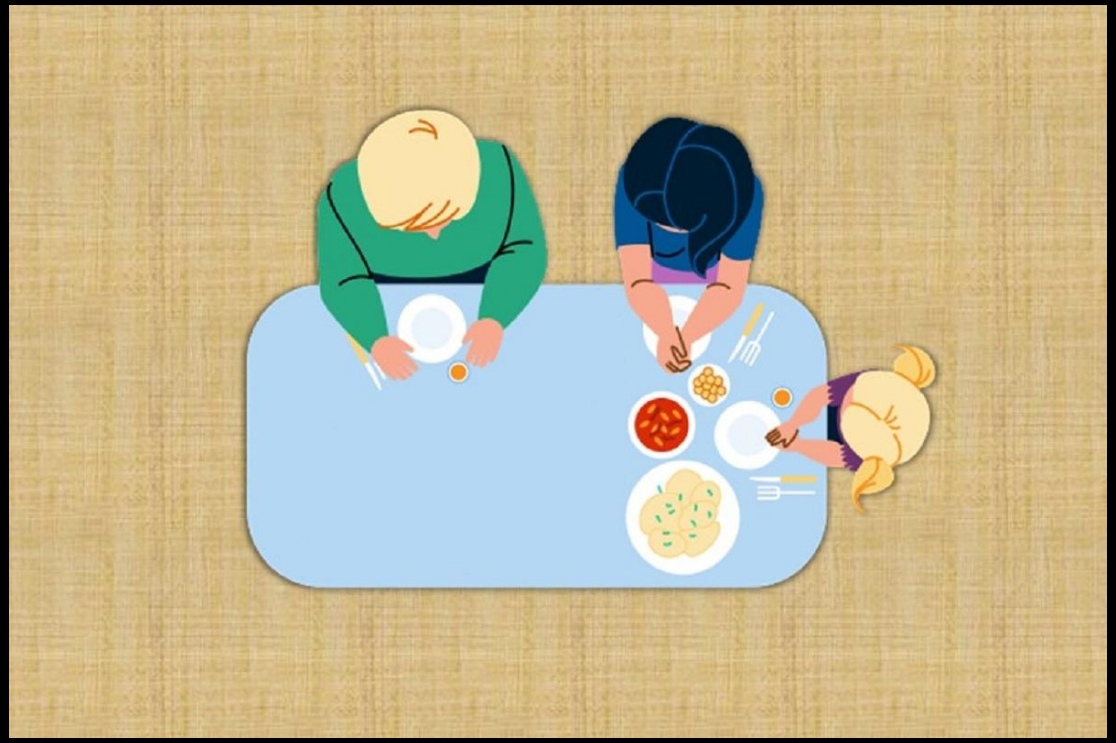
Foresight Obesity Systems Map, 2014

Strategies must focus on early prevention, reaching children & their families in the first 1000 days

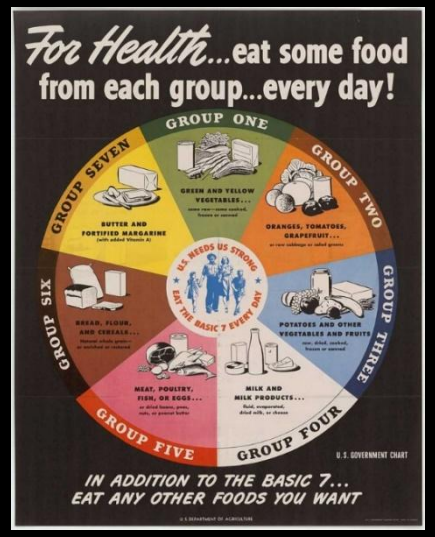
(Blake-Lamb, 2017)



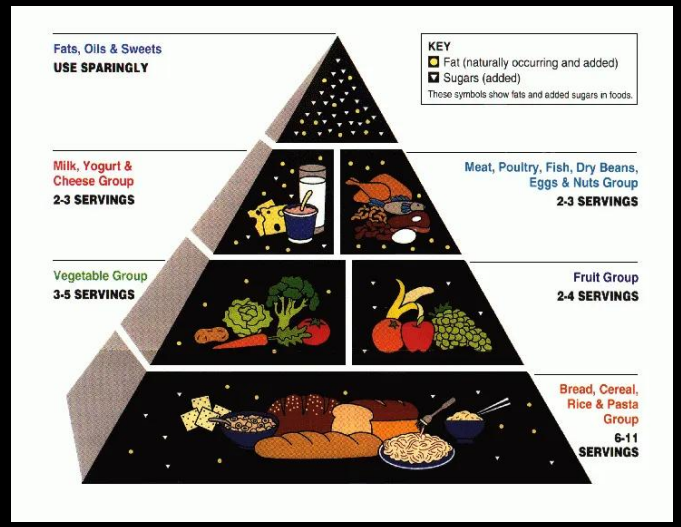
Healthy diets are one key element of obesity prevention.
But, for many families, this is very difficult.



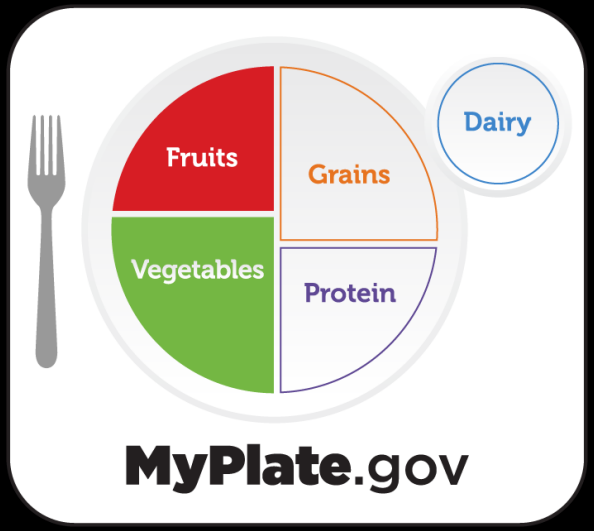
A century of nutrition research and guidance



1940s



1990s



2010s

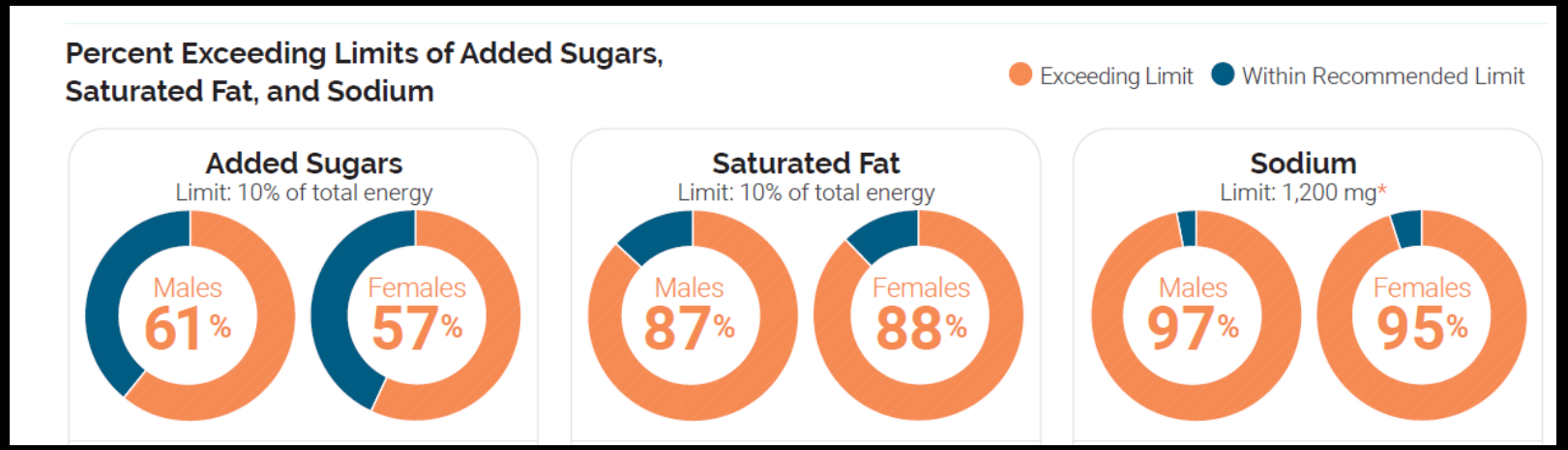


2025

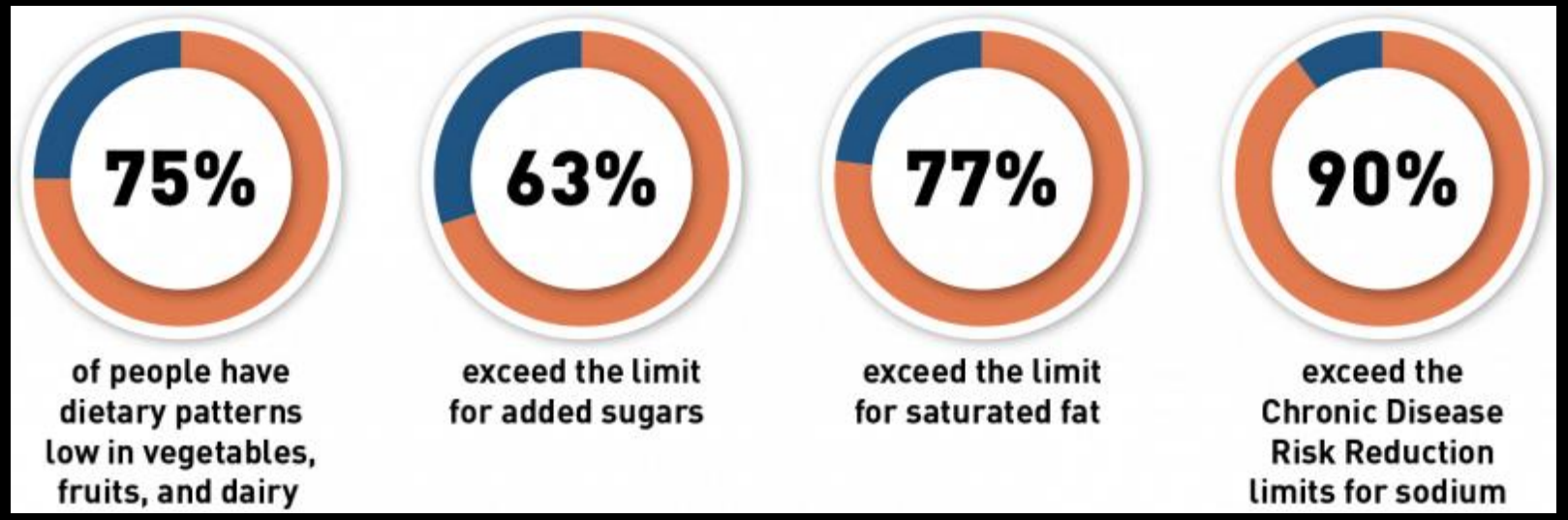
USDA Dietary Guidelines for Americans

But, most Americans don't eat a healthy diet

CHILDREN 2-4 YRS



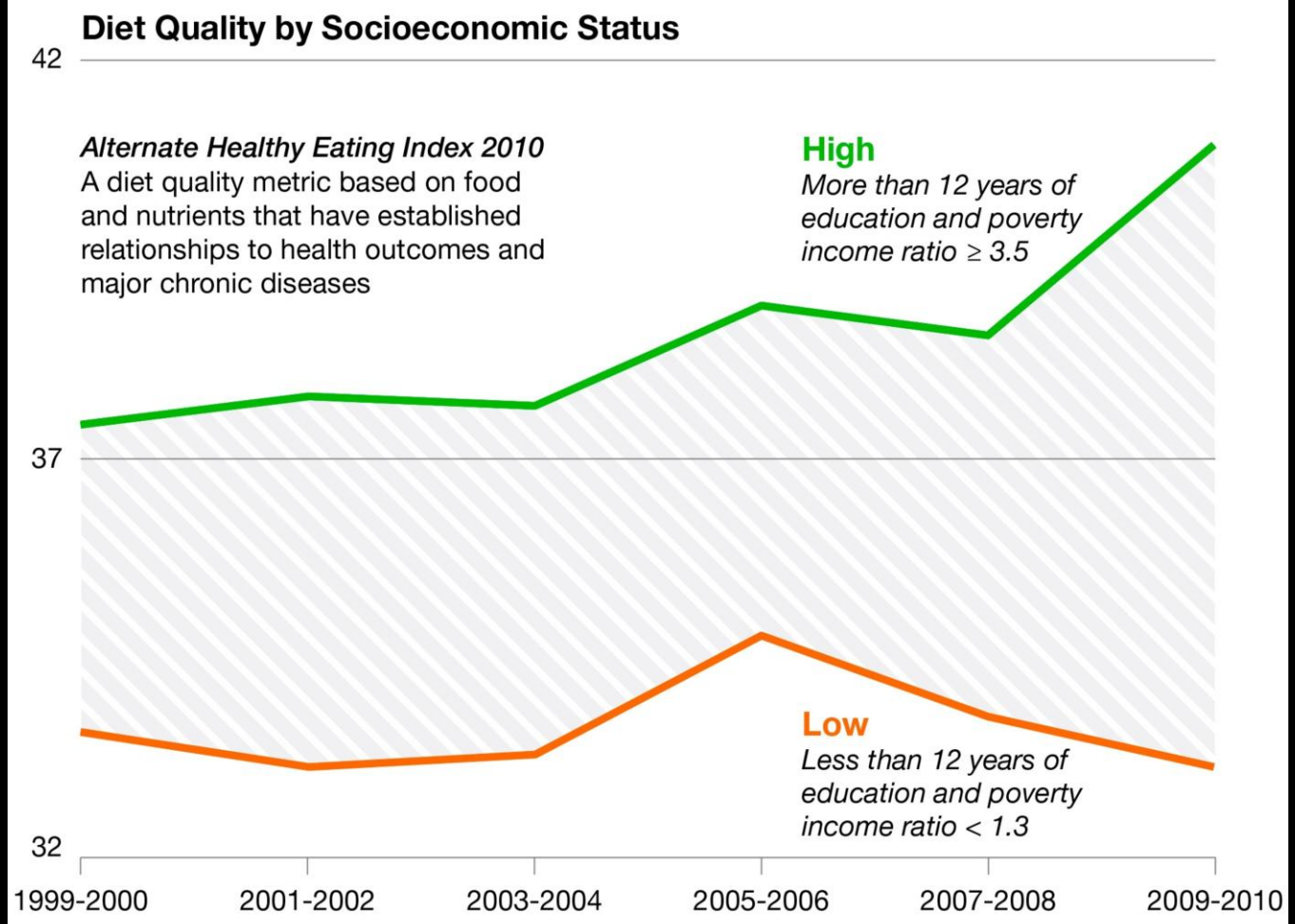
ADULTS



FDA, 2022

The diet quality gap

In the U.S., the gap in the quality of diets has widened between the haves and the have-nots.



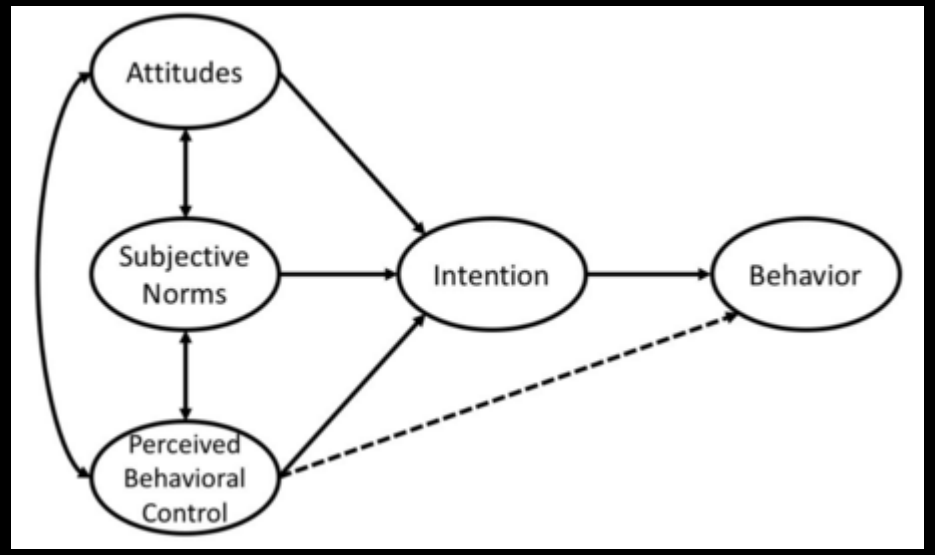
Diet quality scores do not include trans fat component.

National Geographic, 2014

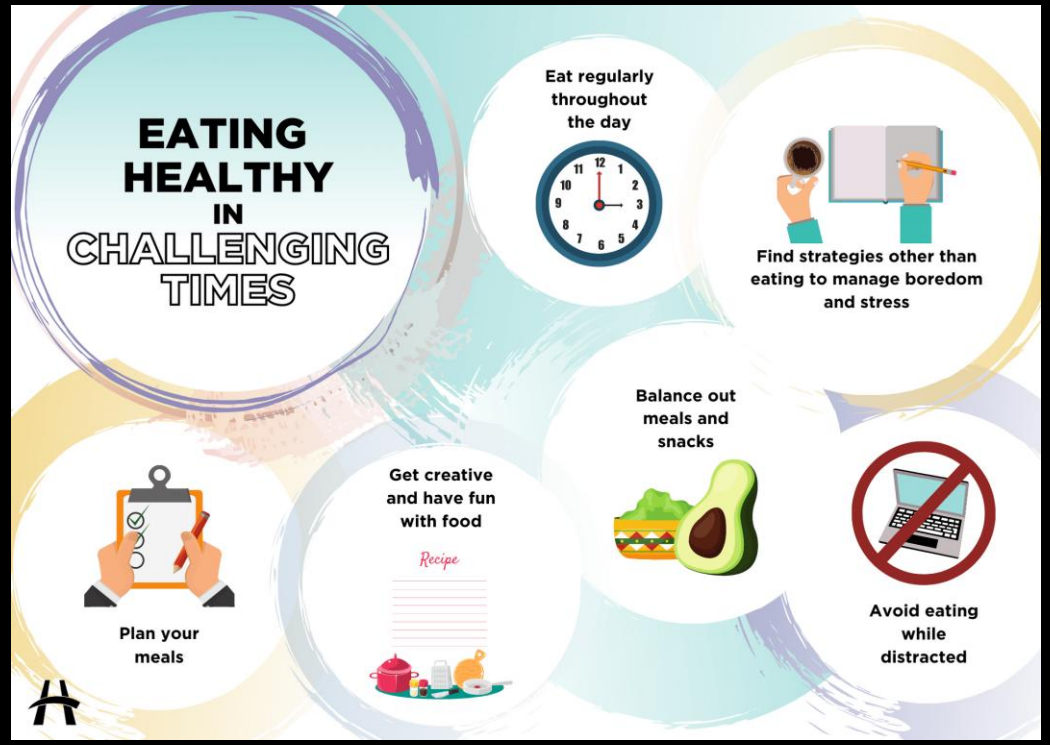
EATING BEHAVIOR THEORY

Eating behavior is influenced by…

- internal physiological and psychological cues (hunger, knowledge, beliefs, emotions) that drive food choices



Theory of Planned Behavior



Hamilton Health Sciences, 2023

EATING BEHAVIOR THEORY

Eating behavior is influenced by…

- internal physiological and psychological cues (hunger, knowledge, beliefs, emotions) that drive food choices
- **habits**, done routinely, with high automaticity in response to cues (Riet et al. 2011, Wood, 2016)

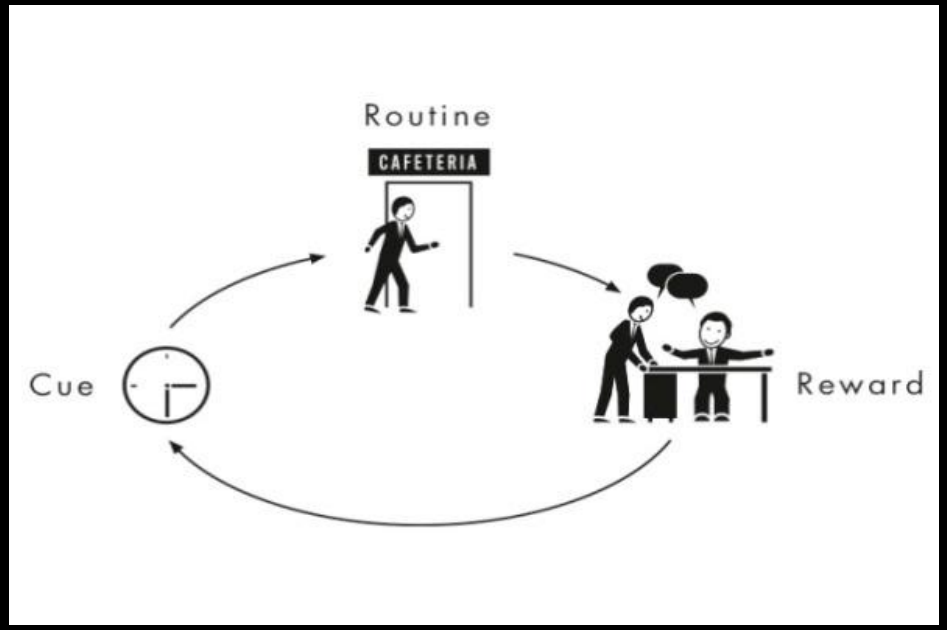


Image: Duhigg, C. 2012. The Power of Habit

EATING BEHAVIOR THEORY

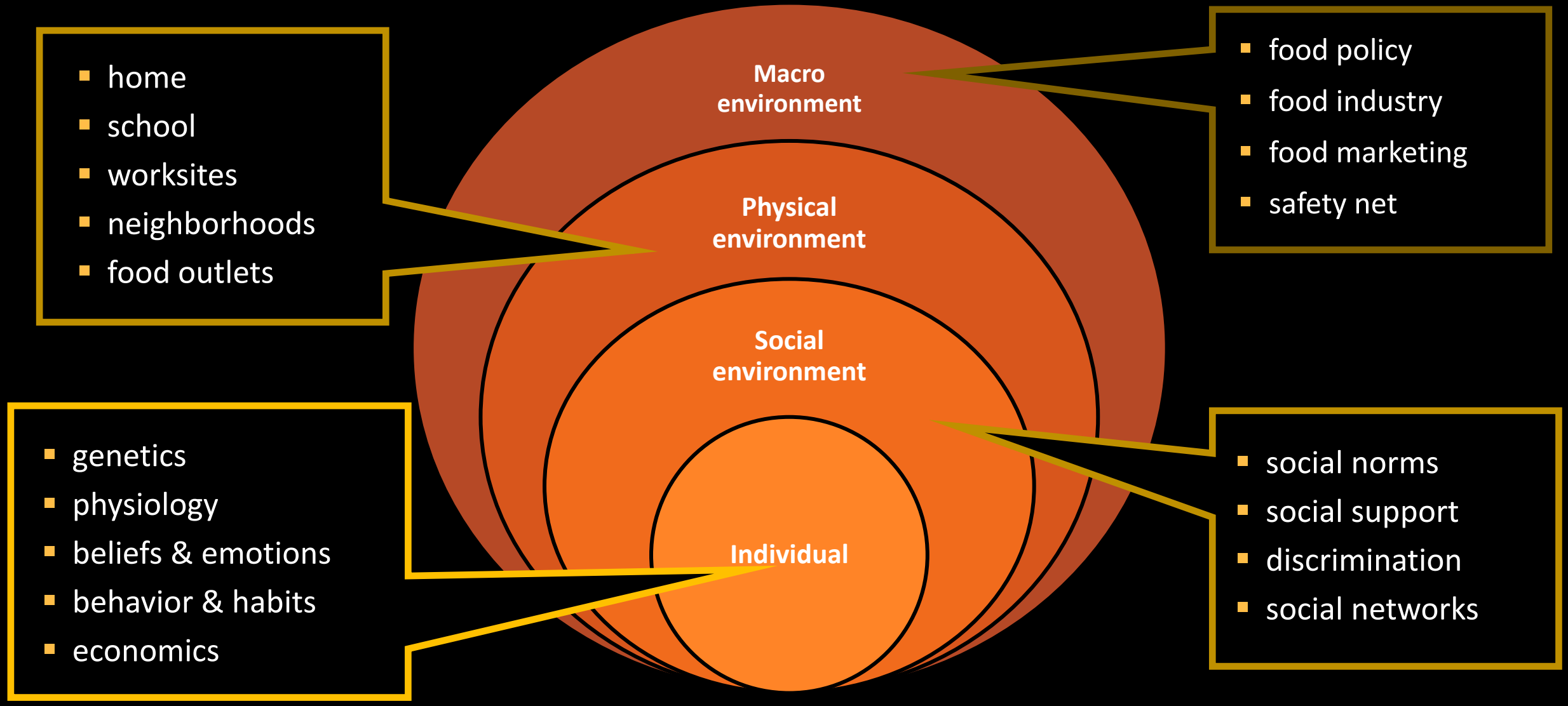
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- internal physiological and psychological cues (hunger, knowledge, beliefs, emotions) that drive food choices
- **habits**, done routinely, with high automaticity in response to cues (Riet et al. 2011, Wood, 2016)
- **health related social needs (aka. social determinants of health)**



Image: Healthy People, 2030

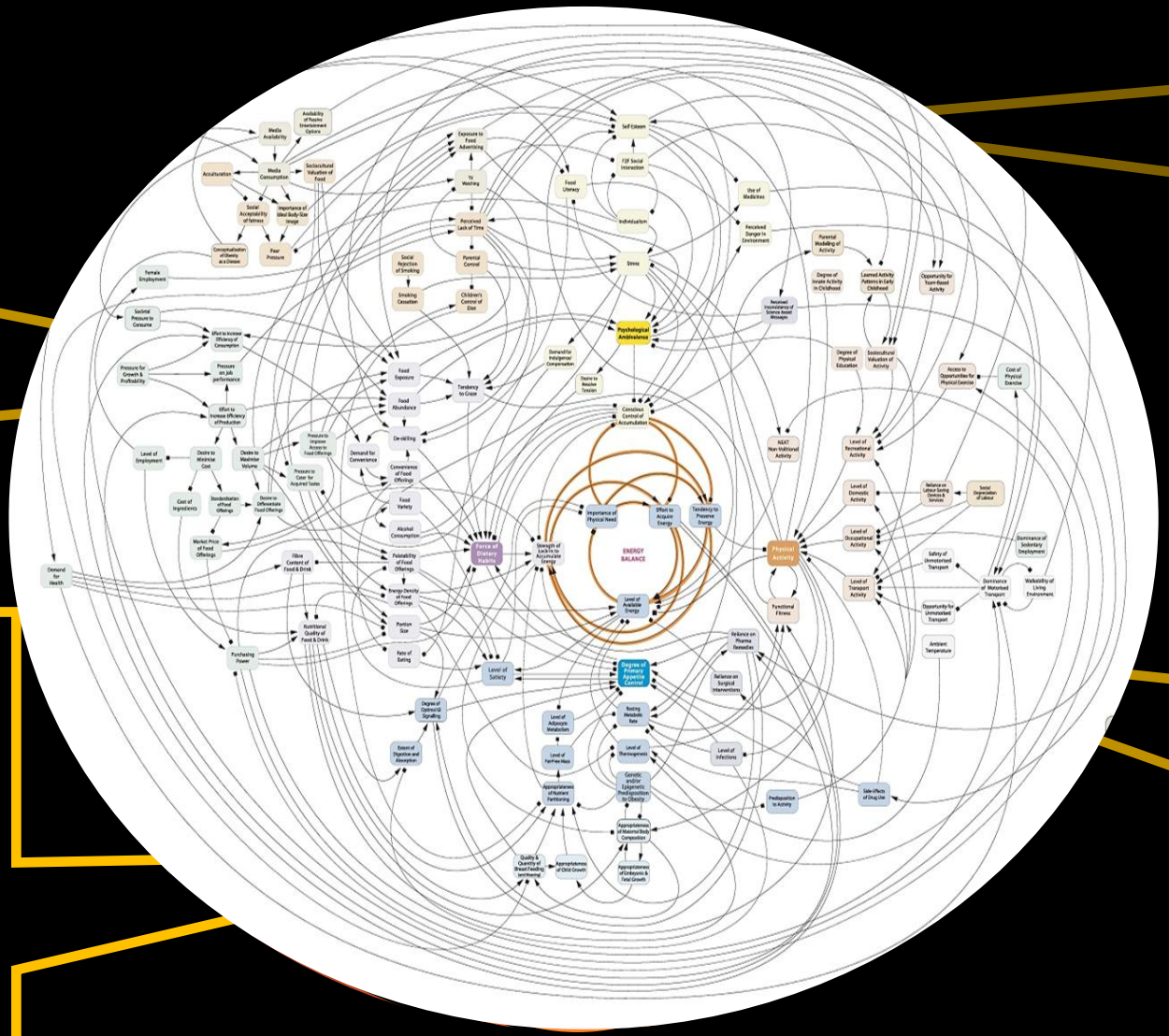
Population dietary change requires systems-focused strategies



de la Haye K, et al. 2023. Ecological risk and protective factors for food insufficiency in Los Angeles County during the COVID-19 pandemic. *Public Health Nutrition*, 26(10):1944-55.

- home
- school
- worksites
- neighborhoods
- food outlets

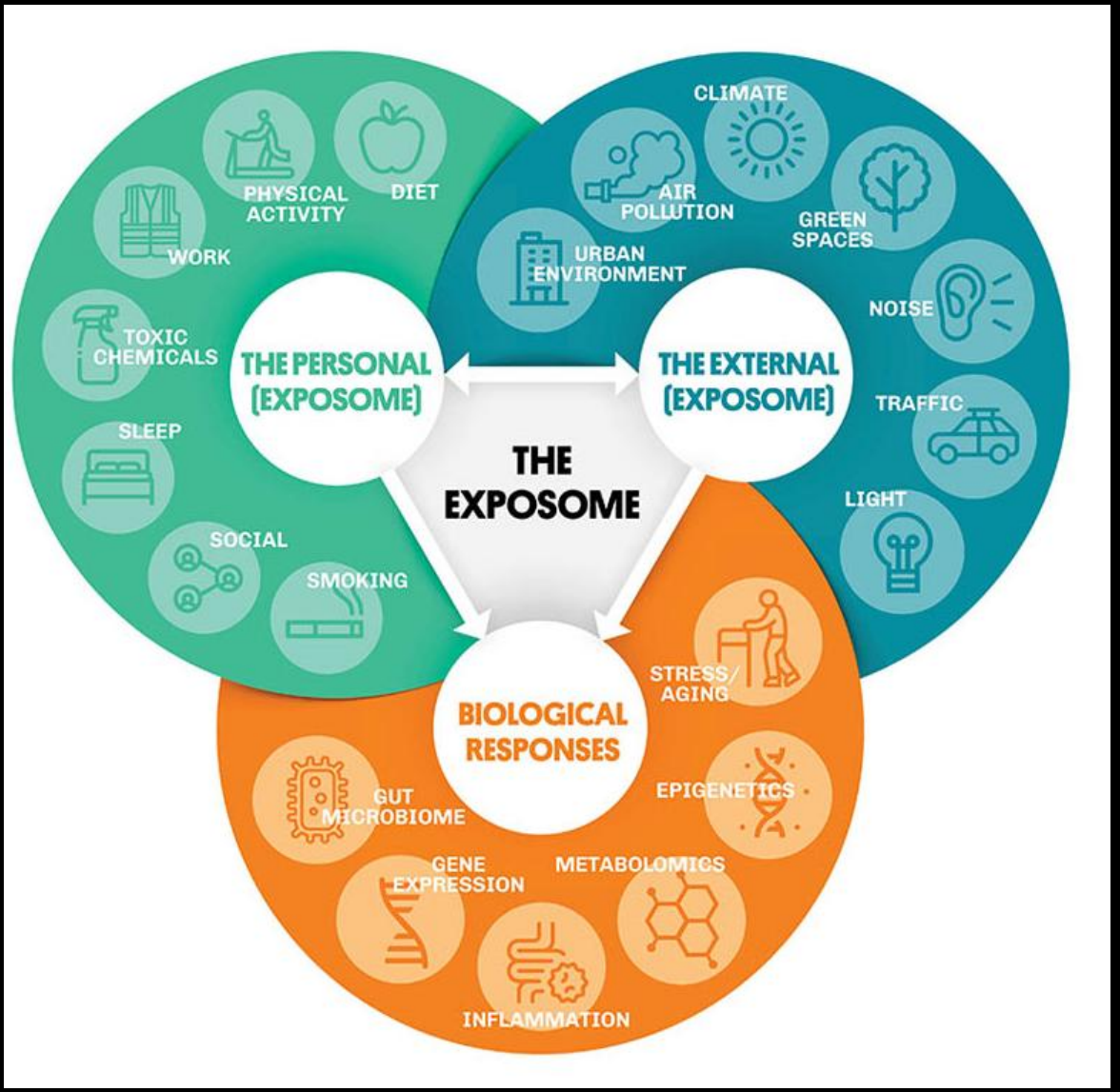
- food policy
- food industry
- food marketing
- safety net



- genetics
- physiology
- beliefs & emotions
- behavior & habits
- economics

- social norms
- social support
- discrimination
- social networks

Image: Foresight Obesity Systems Map



ISGlobal, 2020

OPPORTUNITY

Innovations in measuring, modeling, and modifying our eating exposomes

a complex system of above-the-skin influences

Exposome: the exposure individuals experience 'from conception to death' and how those exposures affect health (Wild, 2005; DeBord, 2016)

Many Americans don't have access to sufficient, healthy food.

- **1 in 4** live in a food desert (USDA, 2019)
- **14%** are food insecure (USDA, 2025)

There is **unequal access** to healthy food among low-income and rural communities, and communities of color — a critical barrier to healthy eating.



GIS Lounge, 2021



Mashable, 2020

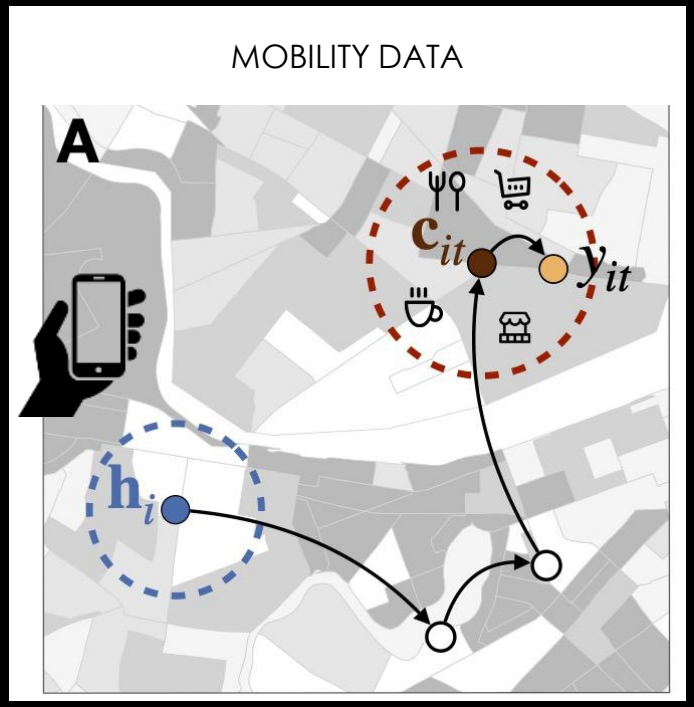
"[My vision is] having more access to food and [it] not being so expensive, because soon we won't be able to buy food."

– Los Angeles resident, 2021

"I just wish we had more options here…but what we've been told is that those corporations…will not invest in coming into communities of color and low socioeconomic, because they feel that we will not purchase you know, expensive organic food."

– Los Angeles resident, 2023

Analysis of smartphone mobility data using AI reveals new insights about how people navigate their food environments.



Bulle Bueno B, Horn, A.,…de la Haye K, Moro E. (2024). Effect of mobile food environments on fast food visits. *Nature Communications,* 15:2291.
Horn AL, … Moro E, de la Haye K. (2023). Population mobility data provides meaningful indicators of fast food intake and diet-related diseases in diverse populations. *NPJ Digital Medicine,* 15;6:208.


Dr. Abigail Horn


Dr. Esteban Moro


Dr. Kayla de la Haye

One day of User K's mobility

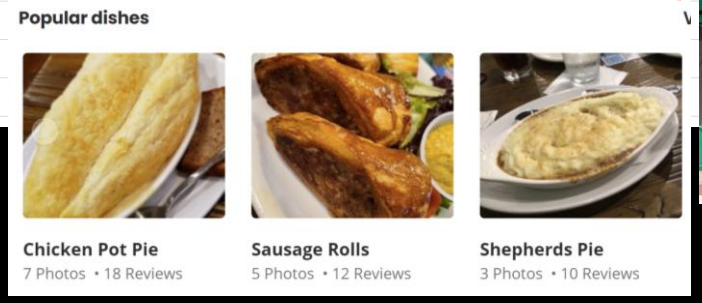
	A	B	C	D	L	N	O
1	**Name**	**Date**	**Lat**	**Lng**	**Battery**	**Visit**	
27	ParticipantK	10/10/2022 7:58	33.94213	-118.399	85%		
28	ParticipantK	10/10/2022 7:59	33.94229	-118.3981	85%		
29	ParticipantK	10/10/2022 8:02	33.94162	-118.3987	85%		
30	ParticipantK	10/10/2022 8:04	33.94026	-118.3994		3 hr 19 min. 10-10 08:04 AM to 10-10 11:24 AM	LAX United Lounge
31	ParticipantK	10/10/2022 15:53	38.94616	-77.4547	65%		
32	ParticipantK	10/10/2022 15:54	38.946	-77.45411	65%		
33	ParticipantK	10/10/2022 15:54	38.94588	-77.45152		22 min. 10-10 03:54 PM to 10-10 04:16 PM	Dulles Airport
34	ParticipantK	10/10/2022 16:18	38.95	-77.45097	60%		
35	ParticipantK	10/10/2022 16:22	38.95315	-77.44813	60%		
36	ParticipantK	10/10/2022 16:24	38.95355	-77.44914		24 min. 10-10 04:24 PM to 10-10 04:48 PM	Dulles taxi line
37	ParticipantK	10/10/2022 16:49	38.95416	-77.44259	60%		
38	ParticipantK	10/10/2022 16:50	38.9621	-77.43654	60%		
39	ParticipantK	10/10/2022 16:51	38.95924	-77.41174	60%		
40	ParticipantK	10/10/2022 16:53	38.95322	-77.38914	60%		
57	ParticipantK	10/10/2022 17:16	38.89072	-77.10332	55%		
58	ParticipantK	10/10/2022 17:17	38.89668	-77.08363	55%		
59	ParticipantK	10/10/2022 17:18	38.89342	-77.0676	55%		
60	ParticipantK	10/10/2022 17:20	38.87453	-77.05261	55%		
61	ParticipantK	10/10/2022 17:21	38.85994	-77.05224	55%		
62	ParticipantK	10/10/2022 17:23	38.85979	-77.05327	55%		
63	ParticipantK	10/10/2022 17:23	38.85858	-77.05194		48 min. 10-10 05:23 PM to 10-10 06:11 PM	Mariott Arlington
64	ParticipantK	10/10/2022 18:12	38.85353	-77.05515		2 hr 2 min. 10-10 06:12 PM to 10-10 08:14 PM	McNamara's Pub
65	ParticipantK	10/10/2022 20:15	38.85602	-77.05302	40%		
66	ParticipantK	10/10/2022 20:17	38.85762	-77.053	40%		
67	ParticipantK	10/10/2022 20:19	38.85838	-77.05301	40%		
68	ParticipantK	10/10/2022 20:24	38.85818	-77.05277	40%		



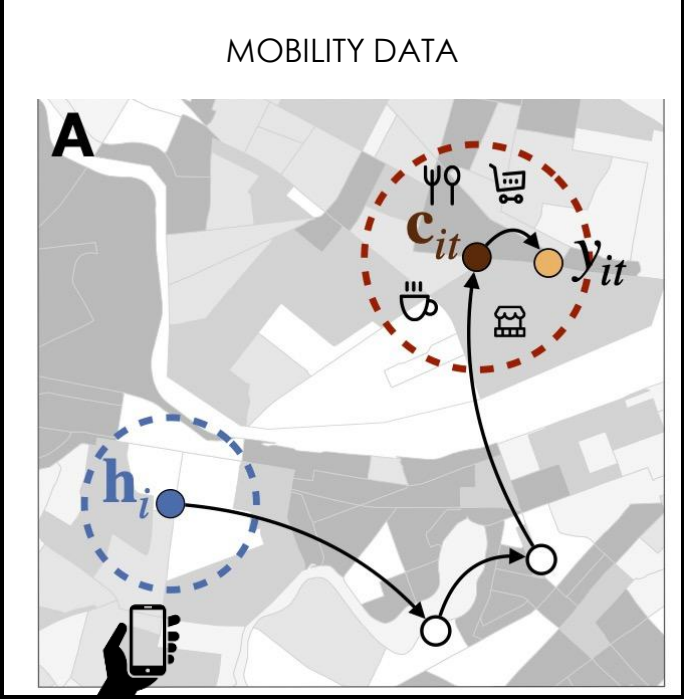


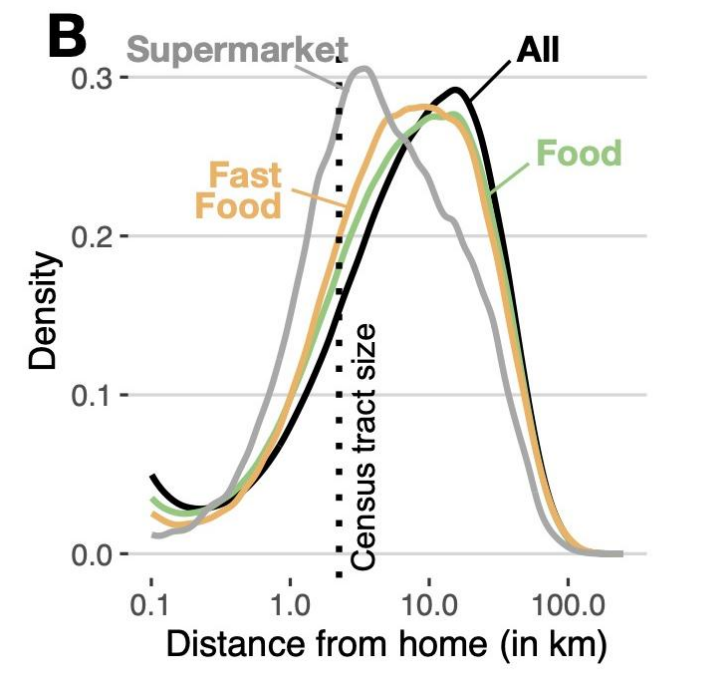






Analysis of population mobility data shows that urban residents visit food outlets miles from their homes.





Bulle Bueno B, Horn, A.,…de la Haye K, Moro E. (2024). Effect of mobile food environments on fast food visits. *Nature Communications,* 15:2291.
Horn AL, … Moro E, de la Haye K. (2023). Population mobility data provides meaningful indicators of fast food intake and diet-related diseases in diverse populations. *NPJ Digital Medicine,* 15;6:208.

2016-2017 Spectus data

11 U.S. metro areas

1.86 million anonymized users

Median distance from home to X

- Any place visited = **4.8 miles**
- Any food outlet = **4.2** miles
- Fast food outlet = **4.2** miles
- Grocery store = **1.9 miles**
- Census tract = avg. 1 sq mile

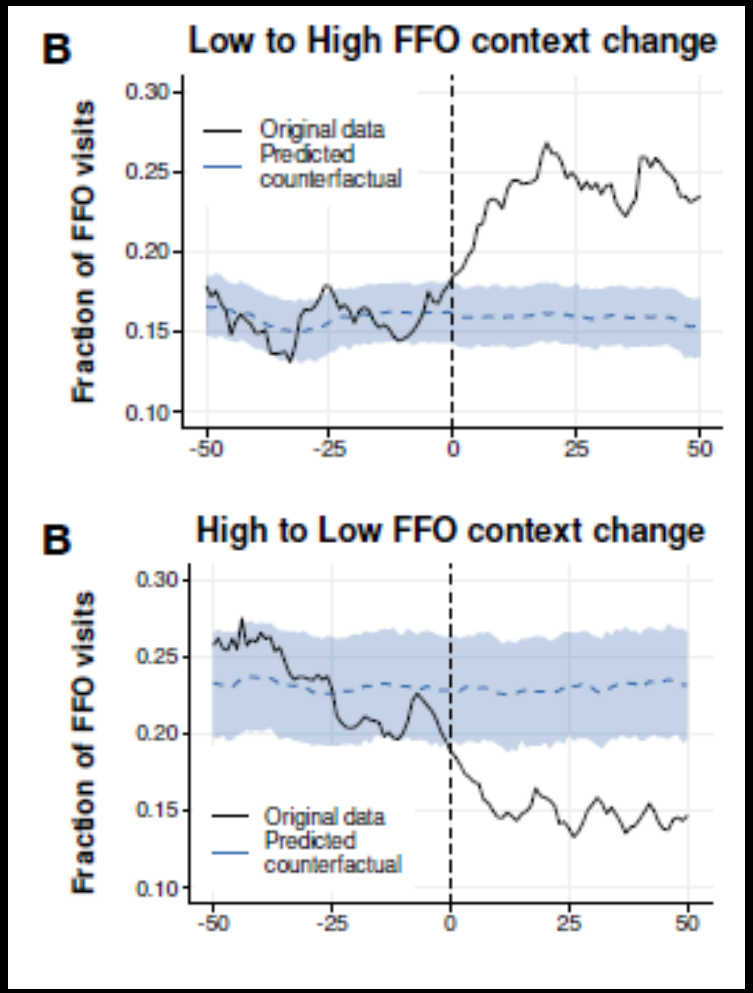
netsi USC mit media lab spectus Data for Good

And, that mobile food environments influence food choice.

As people move around, **exposure** to 'food swamps' **increases** visits to fast food:

- when environment has 10% more fast food (FF) outlets, the odds of visiting a FF outlet increases by ≃ **20%**
- effects of food environment change persist (fig B)

Changing food environments impact food choice

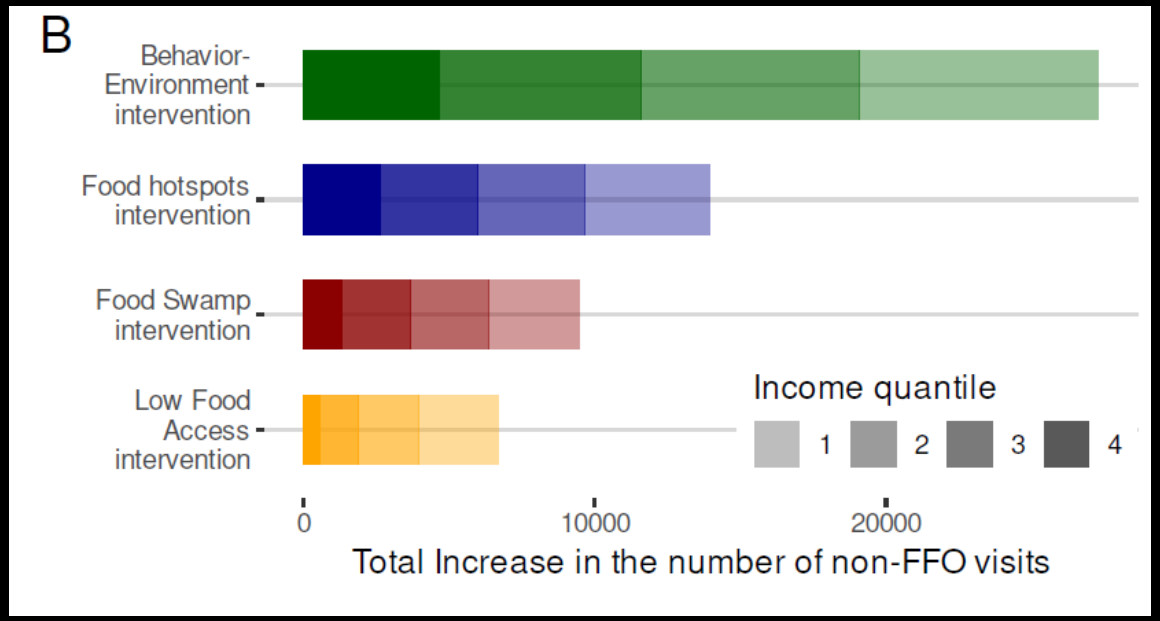


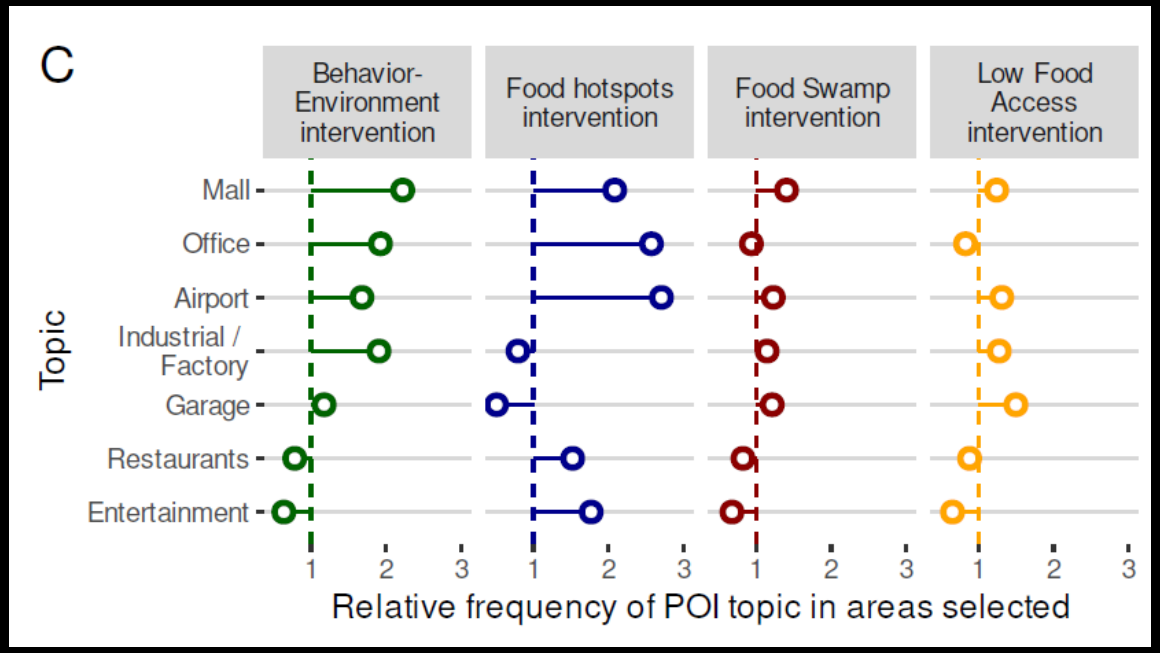
Bulle Bueno B, et al. (2024). Effect of mobile food environments on fast food visits. *Nature Communications,* 15(1):2291.

These insights can inform food environment interventions.

Interventions can optimize for:

- where most unhealthy food visits occur
- where people are most influenced by food environments





Bulle Bueno B, et al. (2024). Effect of mobile food environments on fast food visits. *Nature Communications,* 15(1):2291.

Eating is a social practice.

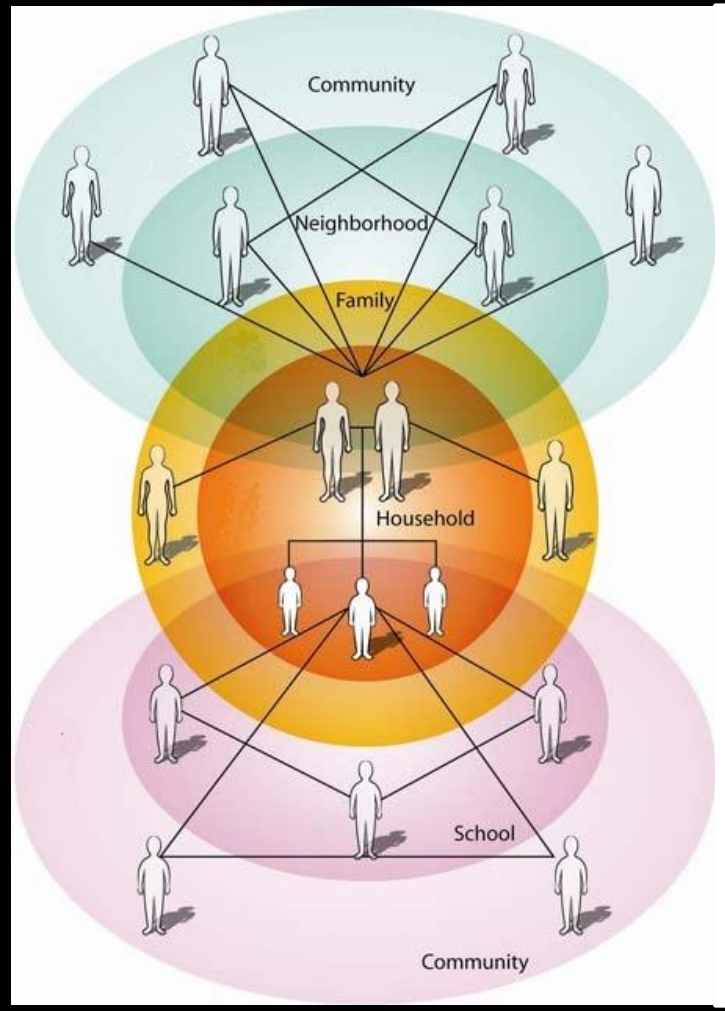
> *...social rules and resources enable or constrain food choices.*

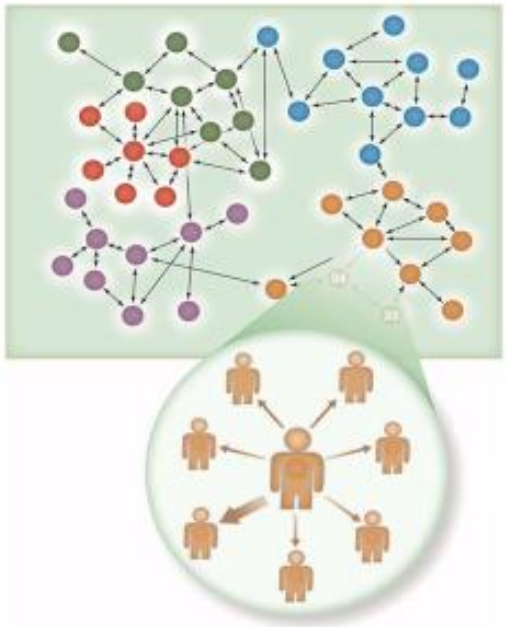


Health Matters. *Obesity and the food environment.*

Delormier, Frohlich, Potvin (2009). Food and eating as social practice – understanding eating patterns as social phenomena and implications for public health. Sociology of Health & Illness, 31, 215-228.

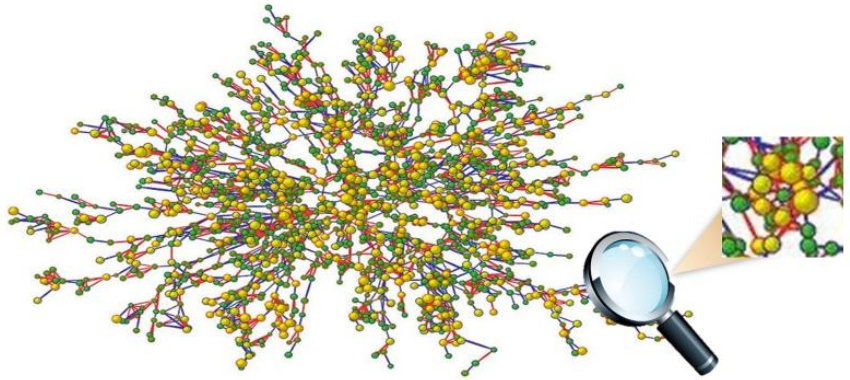
Interventions should recognize eating as a social practice, and account for and address social contexts.





Segmentation:

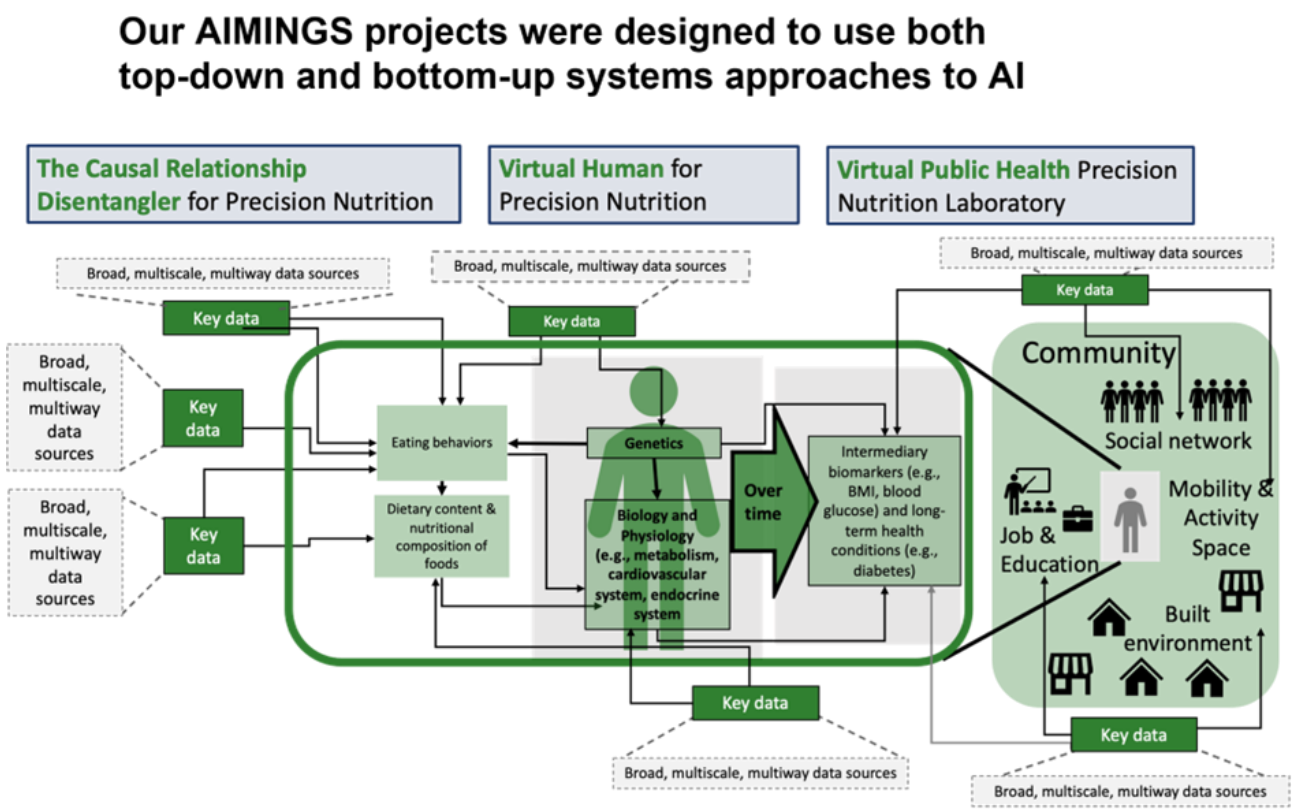
focus on at-risk social groups



Christakis and Fowler, 2007

x

Opportunities for dietary interventions that integrate the complex system of below and above the skin phenomena.



Artificial Intelligence, Modeling, and Informatics for Nutrition Guidance and Systems (AIMINGS) Center

Implements computational and data science approaches and tools to advance **nutrition for precision health** in a way that accounts for the complex systems involved.

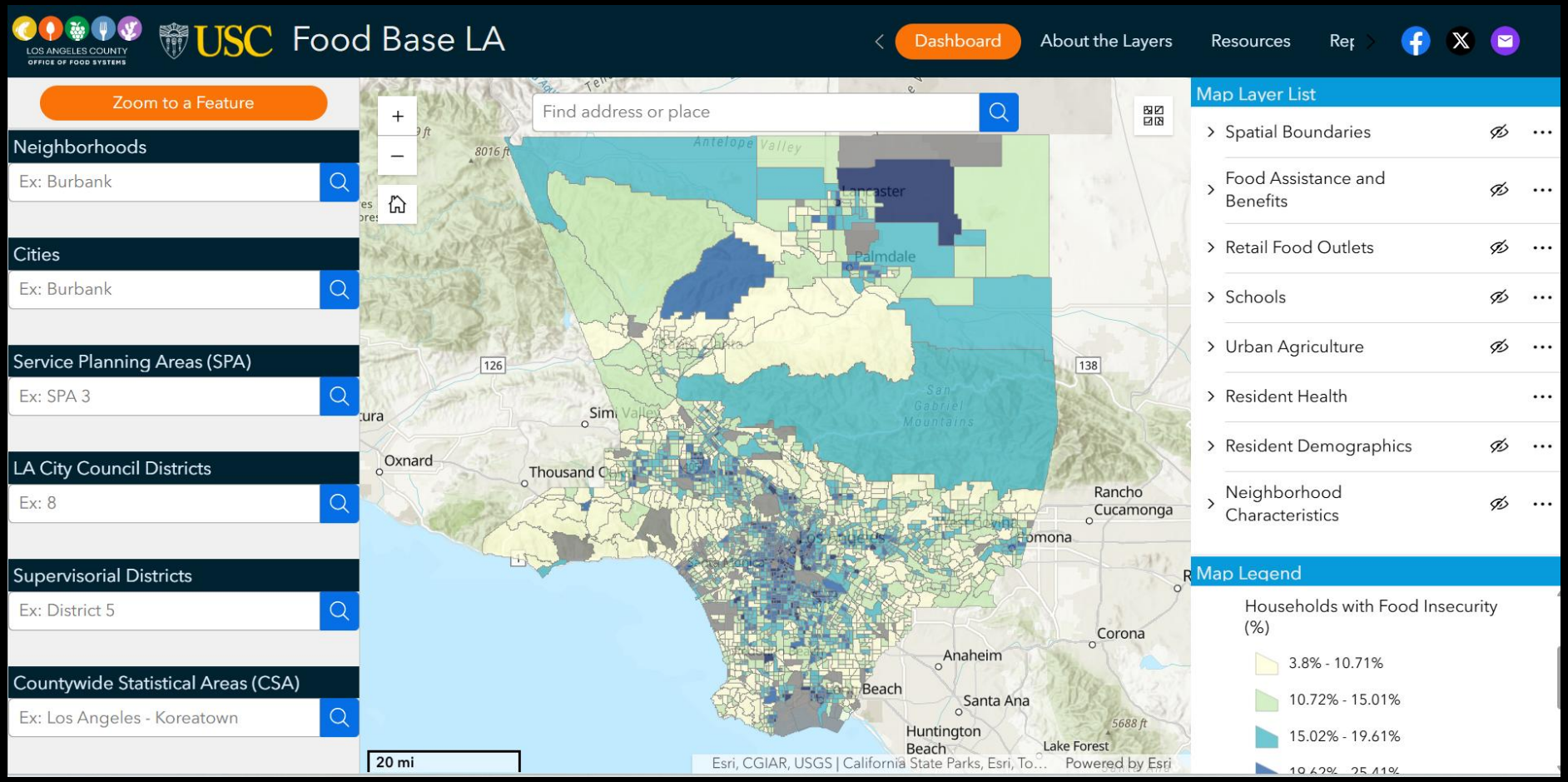
Computational models that:

- enable personalized nutrition tailored to context
- Identify social & environmental levers needed to support personalized nutrition

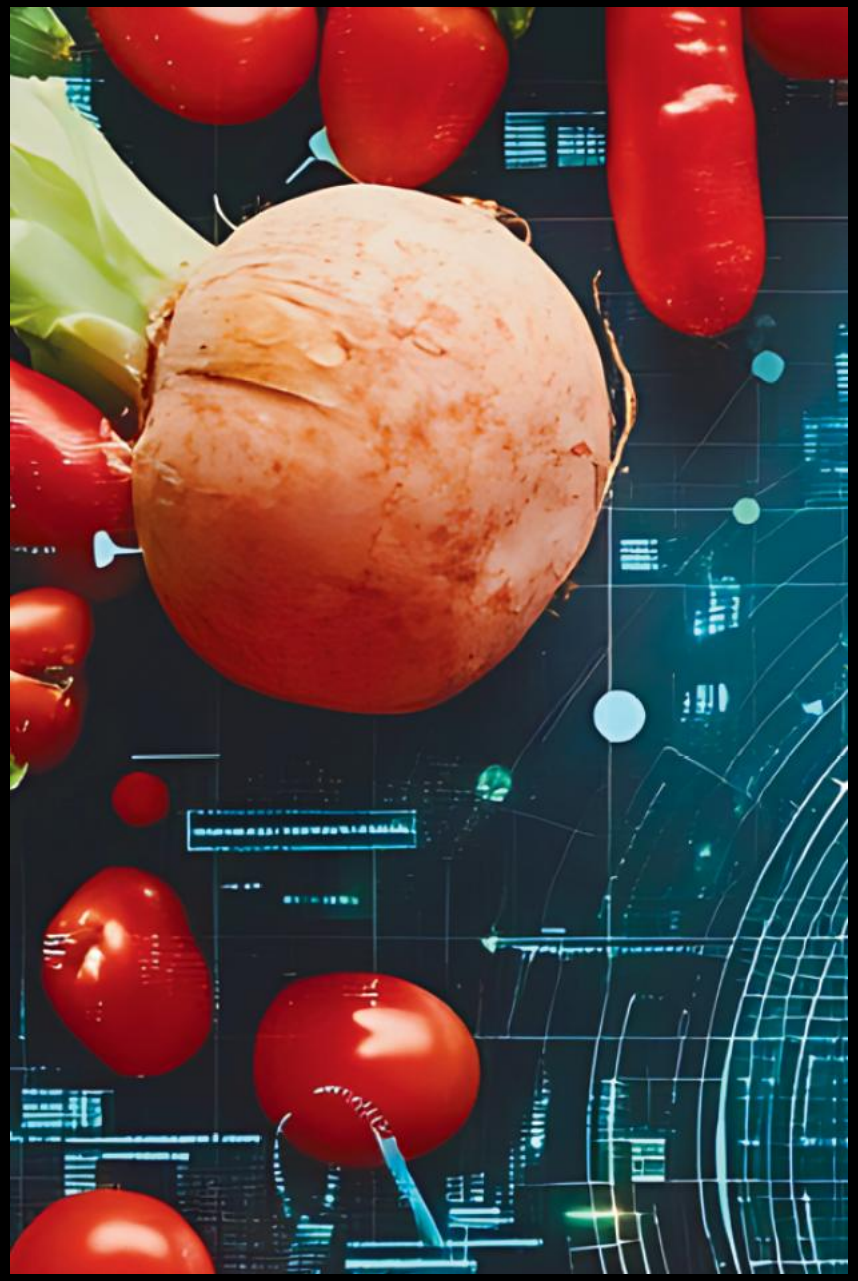
Nutrition for Precision Health | All of Us Research Program | AIMINGS | CUNY SPH Graduate School of Public Health & Health Policy | Stevens Institute of Technology | USC University of Southern California | Johns Hopkins School of Medicine

Opportunities for dietary interventions that integrate the complex system of below and above the skin phenomena.

Data ecosystem and dashboard of granular features of the LA County food system and food exposures.



Food Base LA https://lacountyfoodsystems.org/resources



OPPORTUNITY

Innovative obesity prevention has the potential to…

- account for **complex exposomes**, by monitoring and understanding contexts
- develop behavior change guidance that is **tailored** to a person's ecological context

And, advocate for programs and policies that support food and nutrition security, and equitable food access.

If we want obesity prevention to **translate equitably**, there needs to be fewer barriers to adopting a healthy diets, exercise, and lifstyles.

Thank You

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