Nutrition and Epigenetic Clocks

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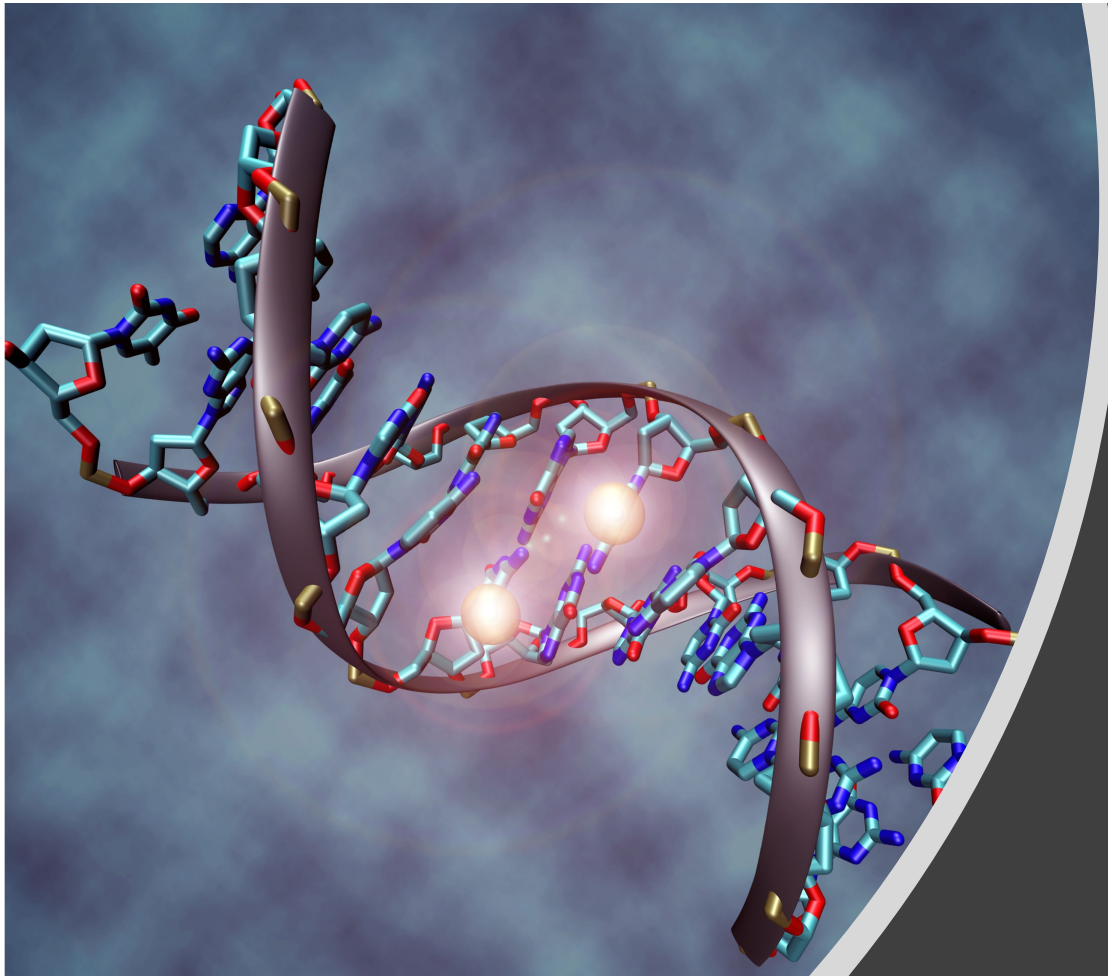
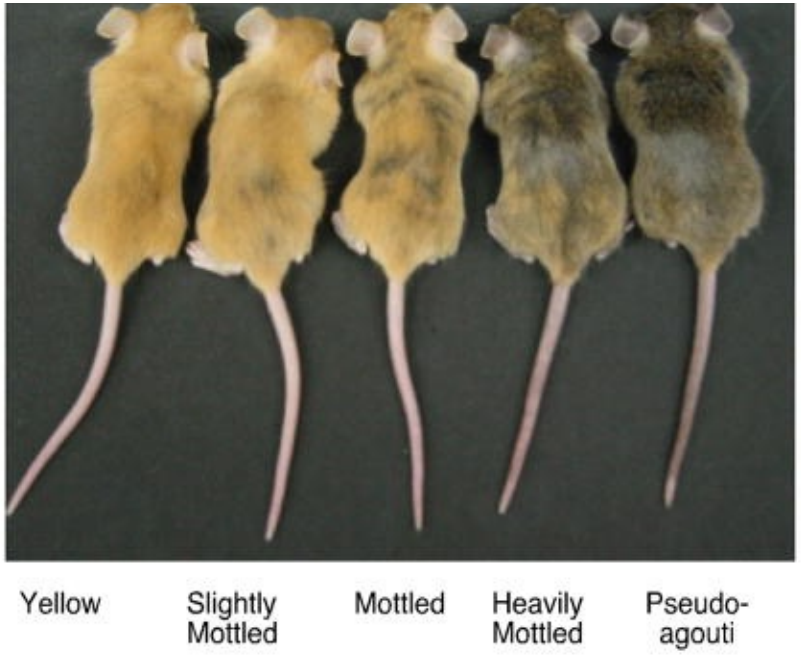


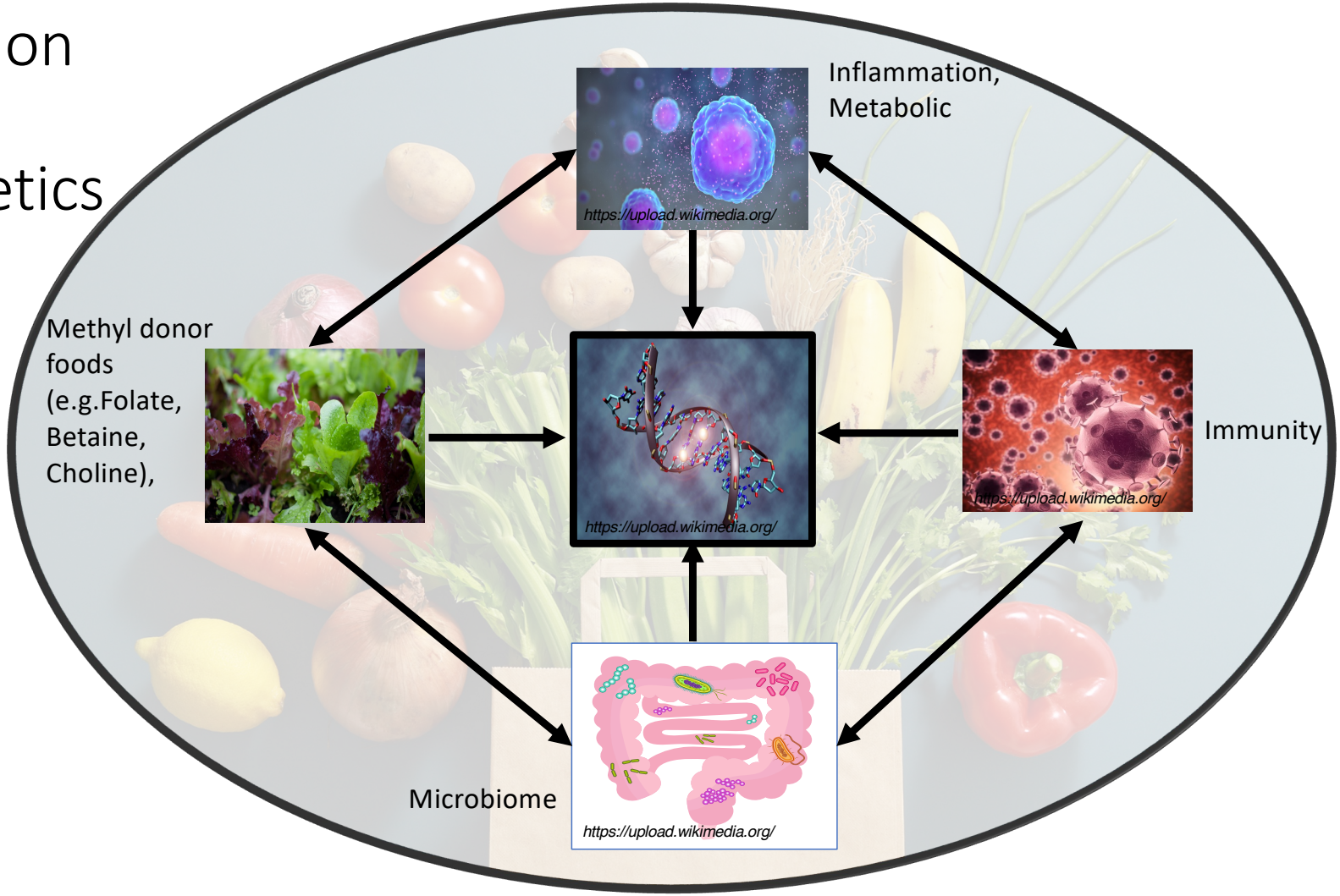
DNA Methylation

Dietary exposures and Epigenetics- Animal models

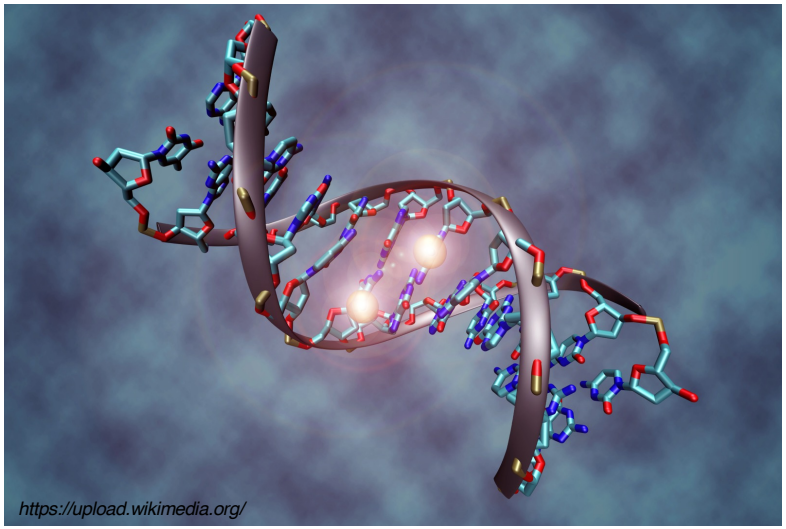
Figure from: Dolinoy, DC. The agouti mouse model: an epigenetic biosensor for nutritional and environmental alterations on the fetal epigenome. *Nutr Rev*. 2008 Aug; 66(Suppl 1): S7–11.



Nutrition and Epigenetics



DNAm Aging or Epigenetic Clocks



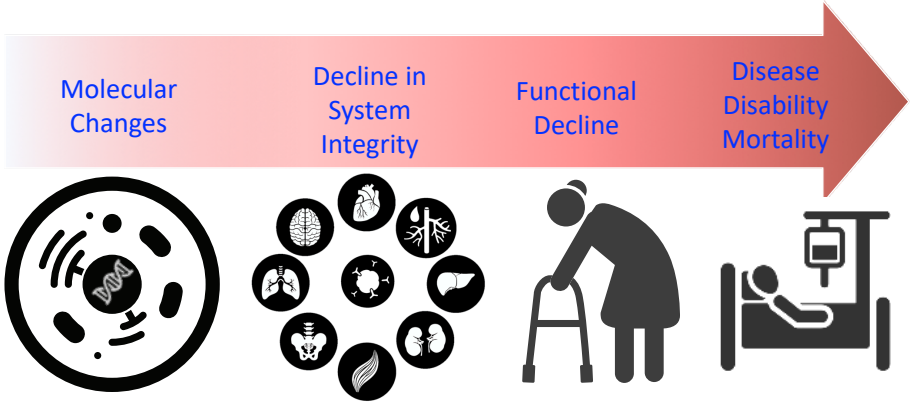


Figure courtesy of D. Belsky

Measurement and Types of Epigenetic Clocks in Nutrition Research

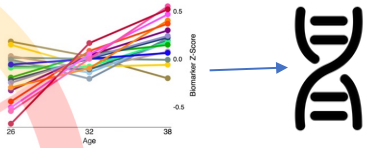
1. **Time since birth –** measure differences between older and younger people

First-gen DNAm clocks (Horvath, Hannum)

2. **Time until death –** measure differences associated with mortality

2nd gen DNAm clocks (PhenoAge (Levine), GrimAge (Lu))

3. **Pace of Aging –** measure differences in rate of decline in system integrity



2nd gen DNAm clock (DunedinPoAm DunedinPACE (Belsky))

Slide courtesy of D. Belsky

Diet and Epigenetic Clocks

Diet quality

Healthy eating patterns

Diet Quality and Epigenetic Clocks

Framingham Heart Study
Three Generations of Dedication

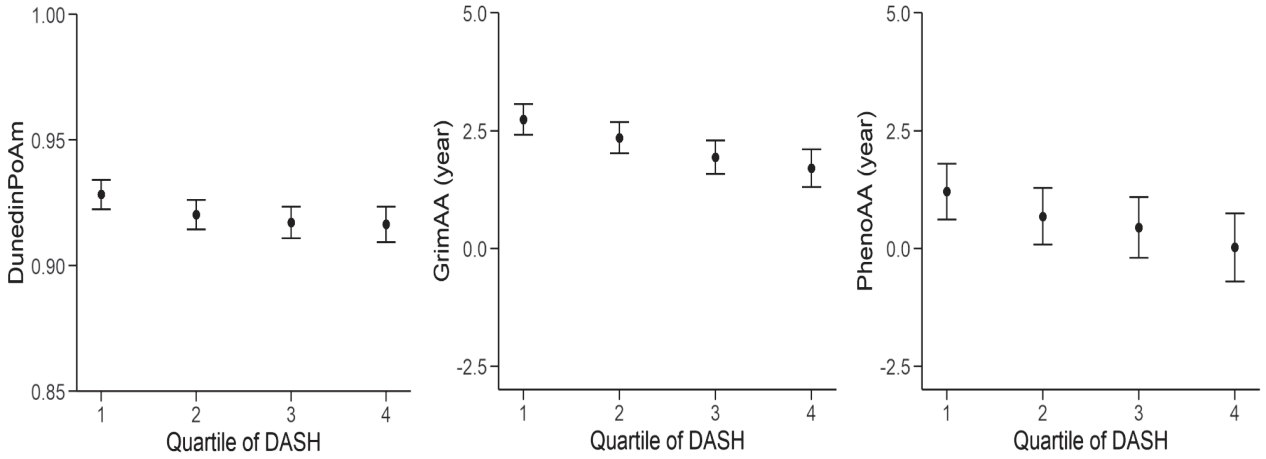


Figure 2 from: Kim et al. *Am J Clin Nutr* 2021;00:1–8

Healthy Eating and Epigenetic Clocks

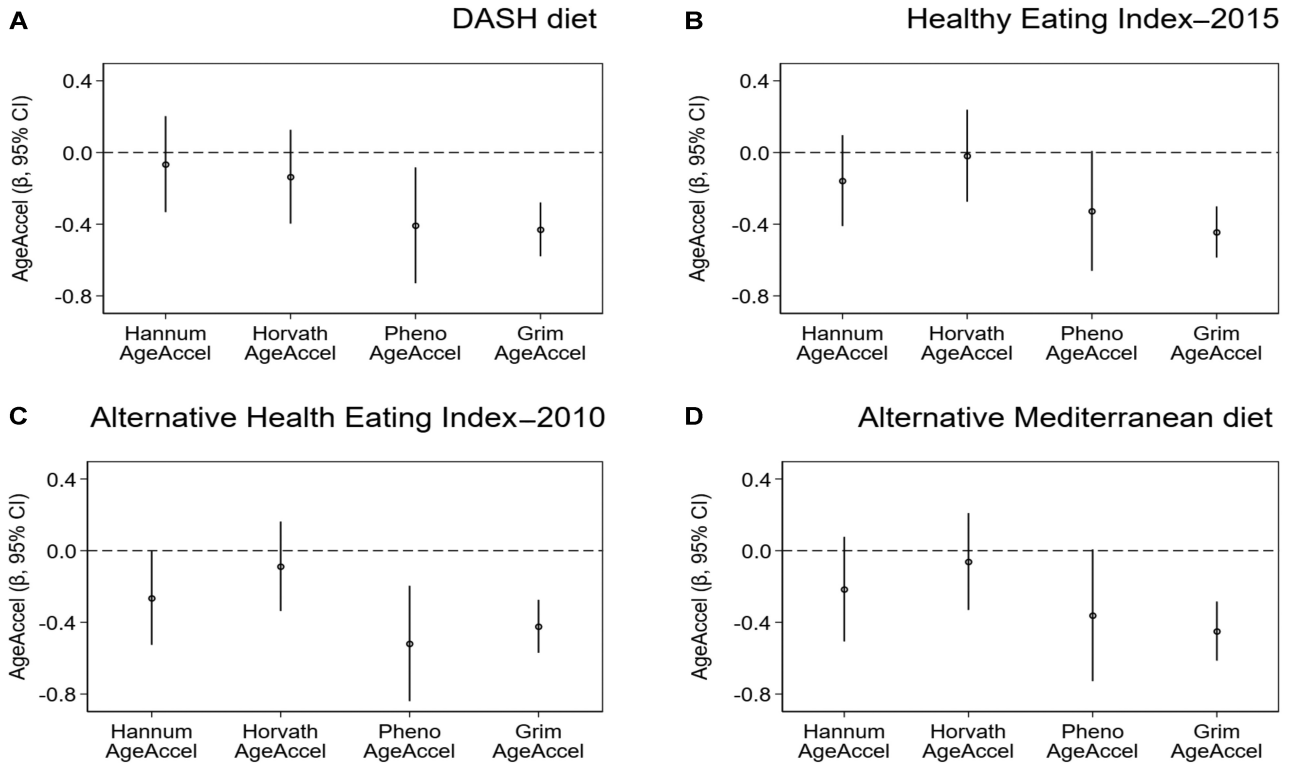


Figure 2 from: Kresovitch et al. *Am J Clin Nutr* 2022:115:171-9

Healthy Eating and Epigenetic Clocks

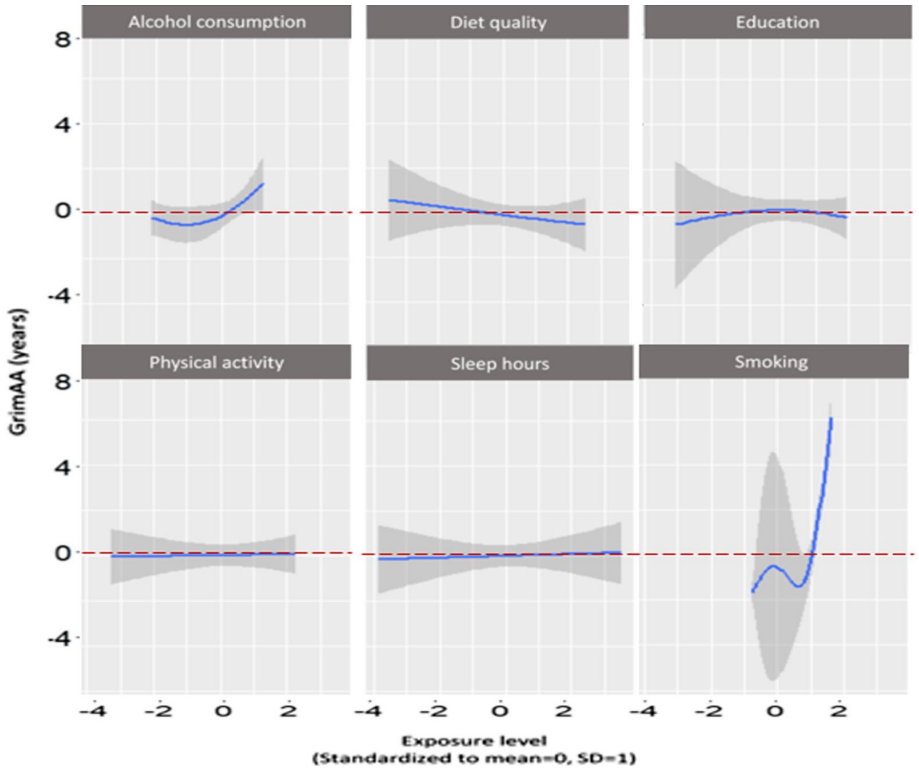


Figure 2 from: Kim et al. *Clinical Epigenetics* (2022) 14:85

Summary

- Identified associations between diet patterns and 2nd generation clocks
- Limited data to suggest that 1st generation clocks are sensitive to diet/eating indices
- Cross sectional studies
  - Mortality selection
  - Temporality
- Lack of overlap across studies: clocks and dietary measures

Nutritional Stressors across the life course

Prenatal exposure to famine

Food Insecurity

Famine and DNA Methylation

Children eating soup. Image: Menno Huizinga/Wikimedia Commons/Public domain

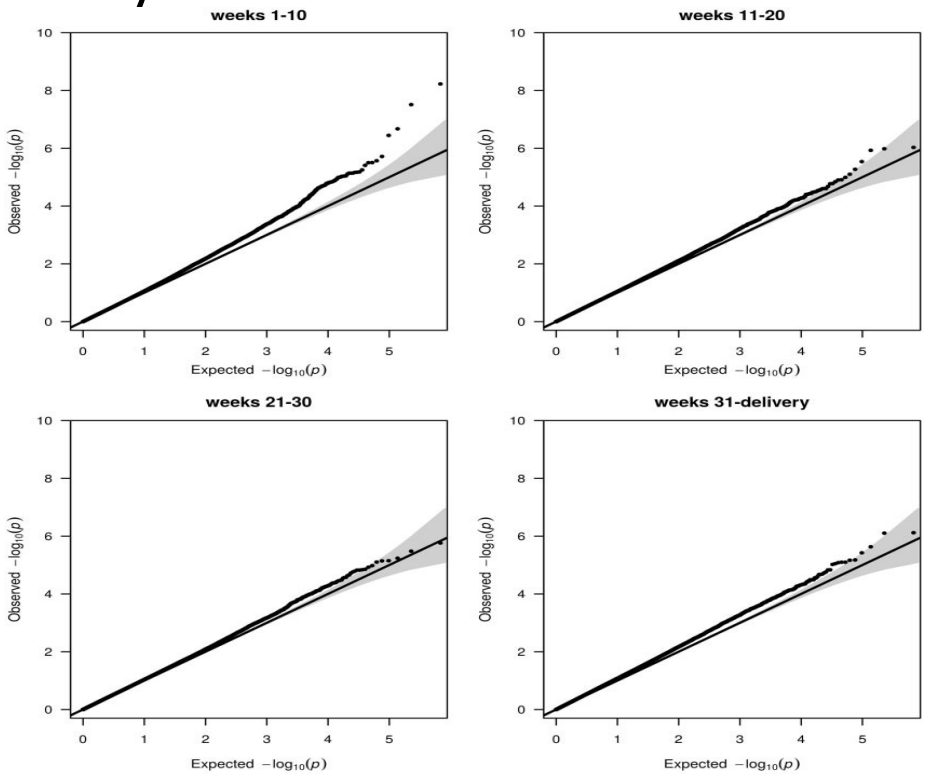
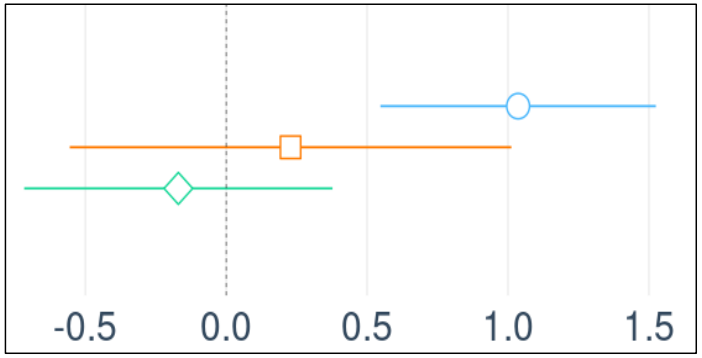


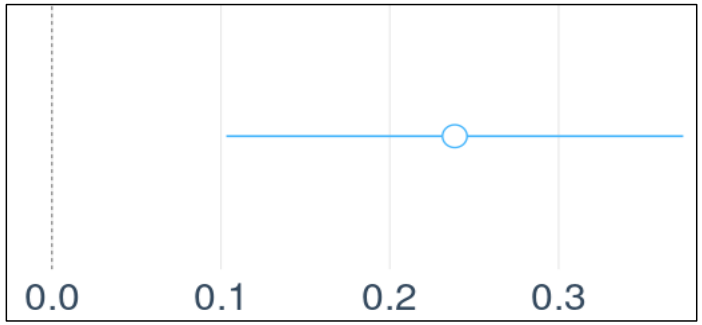
Figure from Tobi et al. *International Journal of Epidemiology*, 2015, Vol. 44, No. 4

Food Insecurity and Epigenetic Clocks- Preliminary Data



Years

GrimAge
PhenoAge
Horvath



Pace

DunedinPace

Covariates: Race, Sex, Education, Smoking

Aiello et al. Unpublished data

Examples of Nutrition or Diet- Related Intervention Studies and biological clocks

Diet, exercise, sleep, relaxation, supplements

Sae-Lee et al. *Mol. Nutr. Food Res*. 2018, 62, 1800092

Fitzgerald et al. *Aging 2021,* Vol. 13, No. 7

Caloric restriction

Ryan, Waziry et al. (In press) Nature Aging

Advantages and Disadvantages of Clocks- Life Course Nutrition Research

Advantages

- Accommodates multiple pathways
- Provides an early sensor
- May provide a window into biological aging prevention

Disadvantages

- Doesn’t provide insight into mechanisms
- Mortality selection
- Not clear if the clocks are as sensitive to small changes
- Cumulative impacts or recent changes?

Summary and Future Work

- Nutrition is associated with epigenetic clocks
- Further research on social and contextual factors
- Longitudinal nutrition and epigenetic clock measures
- A focus on clear hypotheses
  - Reverse biological aging or slow it down?

Thank you and acknowledgements

- Add Health Collaborators: Drs. Aura Mishra, Brandt Levitt, and Kathleen Mullan Harris

- Funding for Add Health
  - National Institute on Minority Health and Health Disparities (NIMHD)
    - R01MD013349 (Aiello and Harris)

  - Add Health Grants: P01 HD31921, 1U01AG071448, 1U01AG071450,