Harmonization of Methods of Diet

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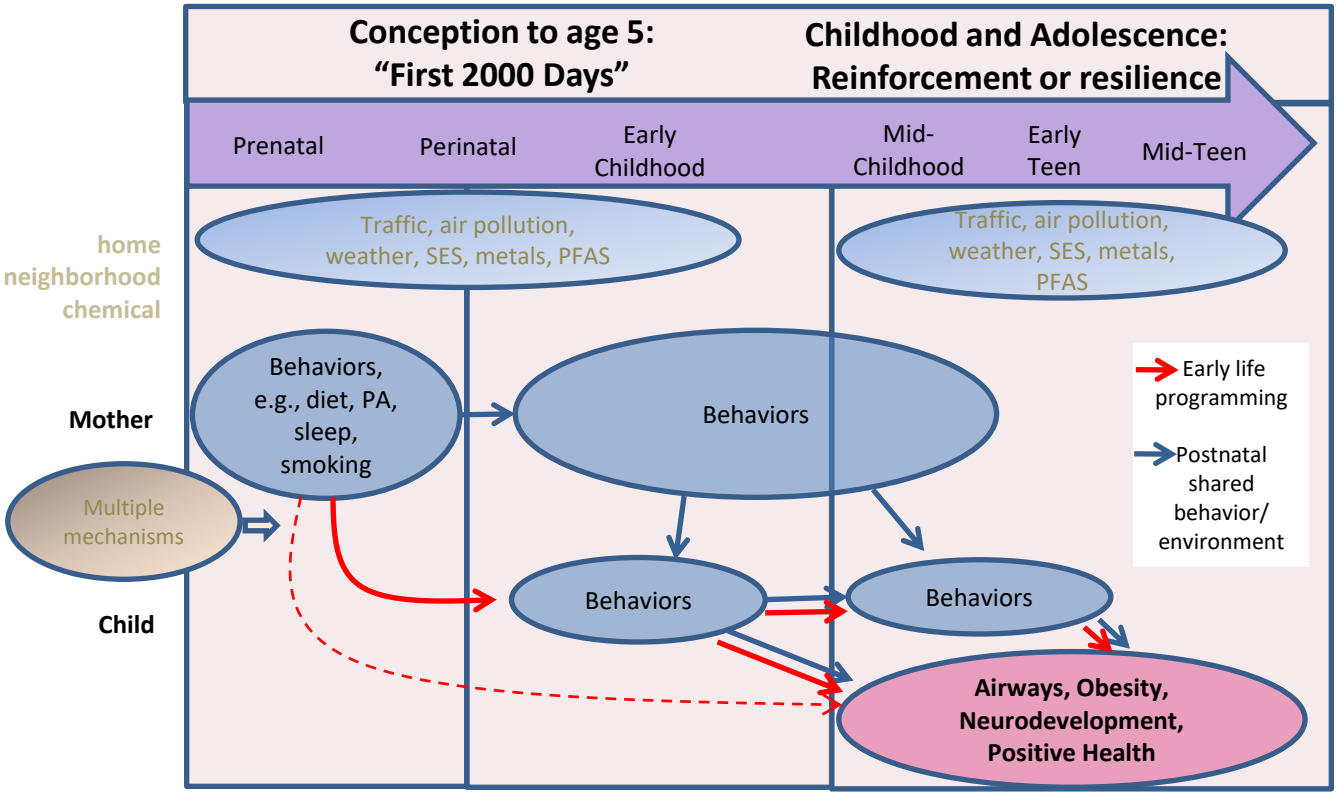
Background - Data Harmonization

- Significant investments in research from participants, investigators, clinical staff, and funding agencies obligates us to share data and specimens wherever possible, provided it is done responsibly.
- NIH is supporting activities to improve data aggregation and harmonization, tools and platforms for data access to maximize the utility of publicly-funded projects and increase the speed of scientific discovery
- NIH-funded Environmental influences on Child Health Outcomes (ECHO), Sept 2016-present
  - 69 ECHO Cohorts, race/ethnic, geographic diversity (~35,500 pregnancies; 58,000 children)
  - Goal to create a harmonized, curated, combined database to help understand effects of early life exposures (pregnancy to age 5) on child health and development

Distinguishing modes of transmission critical for intervention design



Adapted from figure by Emily Oken

Harmonize, curate, analyze

1) Careful review of processes and procedures related to data collection
2) Document harmonization process and include pertinent metadata (e.g., mode of administration, reference period)
3) Evaluate the success of the harmonization process. Conduct analyses to identify differences as a function of metadata, studies contributing data

- Determining whether there is sufficient compatibility for aggregation is scientifically and technically challenging as well as time and labor-intensive!
- Optimal to use team-science approach with statisticians, investigators involved in the original data acquisition, and subject matter experts

Understanding the research question

- Energy intake
- Micro-, macro-nutrient intake (usual intake)
- Intake of specific foods (e.g., fish), food groups (e.g., fruit and vegetable)
- Diet quality (e.g., Healthy Eating Index)
- Consideration of supplements - level of detail about nutrient composition in the supplement may vary or not exist for given measurement method

Factors (metadata) that need to be accounted during harmonization

- Population (pregnancy, infancy, early childhood, mid-childhood to adolescence)
- Informant (self-report, proxy-report),
- Collection (number of recalls, FFQ reference time frame)
- Mode of administration (online, phone, in-person)
- Measurement (FFQ, 24h recall, remote photography, screener vs. full administration)
- Changing instrument versions and nutrient databases over time

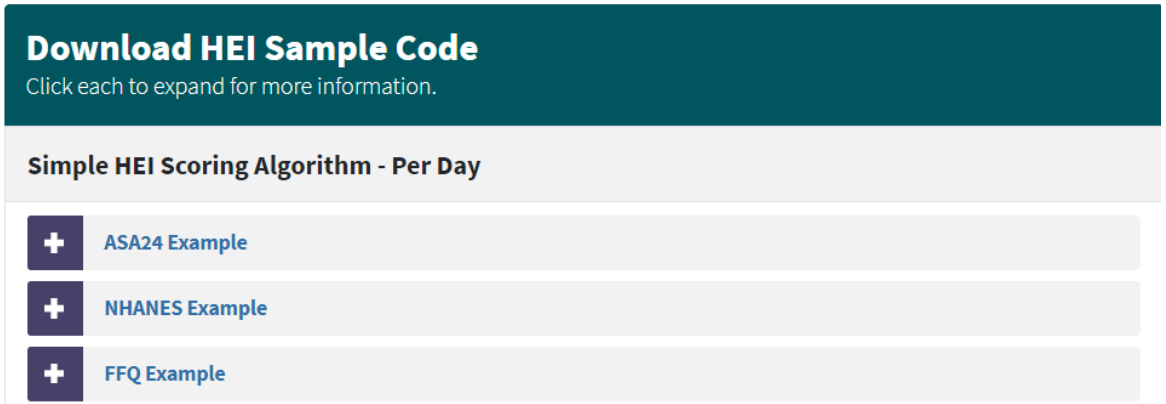
Diet data available in ECHO

- 24h recalls
  - ASA24®: versions 2011, 2016, 2018, 2020
  - Nutrition Data System for Research (NDSR)
- FFQs
  - Harvard FFQ¶ – diet during pregnancy
  - Block 2005 FFQ* – diet during pregnancy
    - Reference period: “since becoming pregnant”, 3-months, 4-months, 12-months
    - Enhancements: vitamin supplements, omega-3 focused questions (separate fish intake section, and foods for omega-3 fatty acids), microbiome focused questions
  - Block FFQ – child diet
    - Full versions for ages 2-7, 8-18 and screener for ages 2-18
  - NCI Dietary History Questionnaire (DHQ): 2nd and 3rd Editions
    - proxy-report (ages 2-10 years), self-report (ages 11+)

* https://www.nutritionquest.com/assessment/list-of-questionnaires-and-screeners/
¶ https://regepi.bwh.harvard.edu/health/nutrition.html

Harmonization of methods to measure diet quality

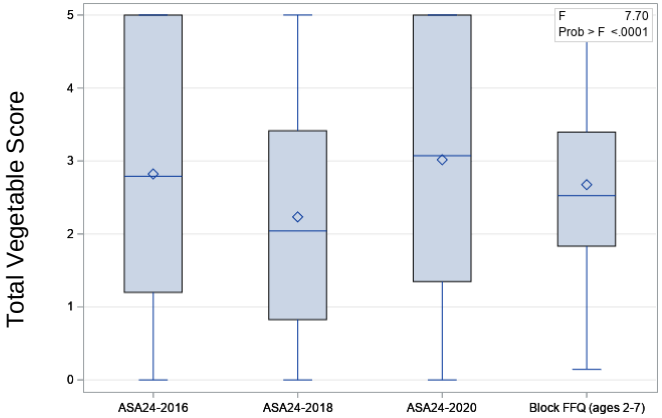
- Measure of diet quality: Healthy Eating Index (HEI) 2015
- Cross-walk output from 24h recalls versions and platforms (ASA24, NDSR)
- Cross-walk output from FFQ versions and instruments (Block, Harvard, DHQ)
- Algorithms available for calculation of HEI2015*

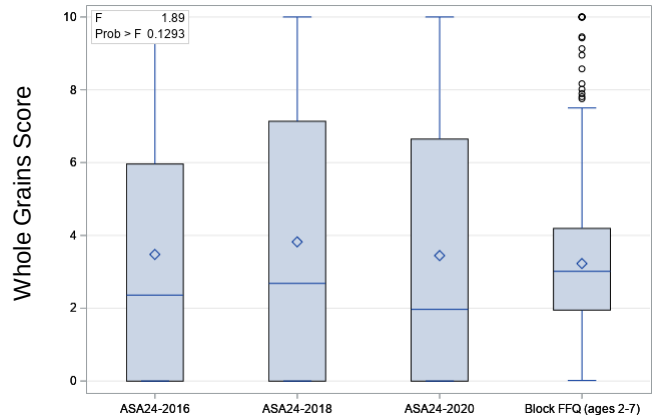


- Did not standardize nutrient database, did not use dietary screeners

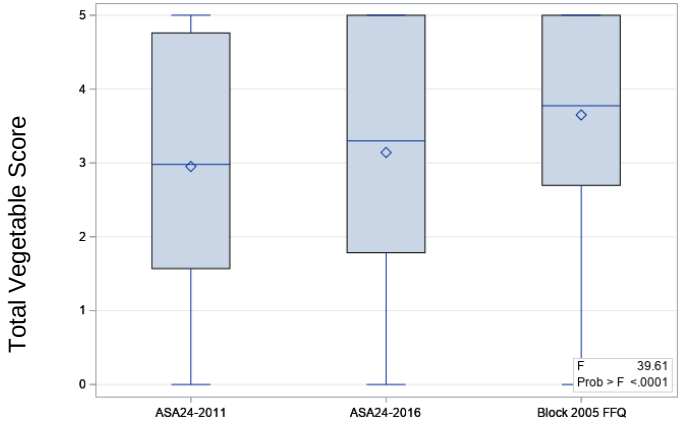
*https://epi.grants.cancer.gov/hei/sas-code.html

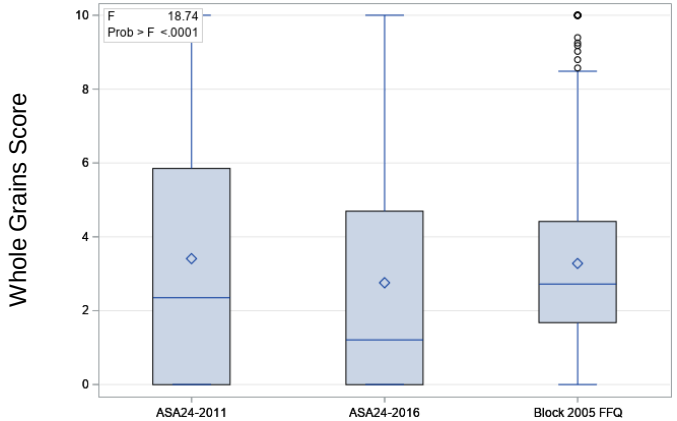
HEI2015: children ages 2-7





HEI2015: maternal diet during pregnancy





Harmonization of methods to measure nutrient intake during pregnancy

- 15 prenatal ECHO cohorts contributing data on 9,686 pregnant women
- Prenatal diet assessed with 24-hour recalls (5 cohorts; n=1860) or FFQs (10 cohorts; n=7838)
- Individual cohorts calculated average daily intake using appropriate nutrient databases + dietary supplement labels
- Did not combine data across methods
  - Assessed the difference in mean intake for each micronutrient between methodologies (recall vs. FFQ) using t-test. All tests were statistically significant at Bonferroni-adjusted alpha.

Katherine Sauder*, PhD, MPH, University of Colorado. Sociodemographic and Obesity-related Disparities in Risks of Inadequate and Excessive Intake of Micronutrients during Pregnancy. *Manuscript under review.*
*NASEM Workshop Webinar 1: Methods for Dietary Assessments during Pregnancy. May 6, 2021

Harmonization of methods to measure nutrient intake during pregnancy

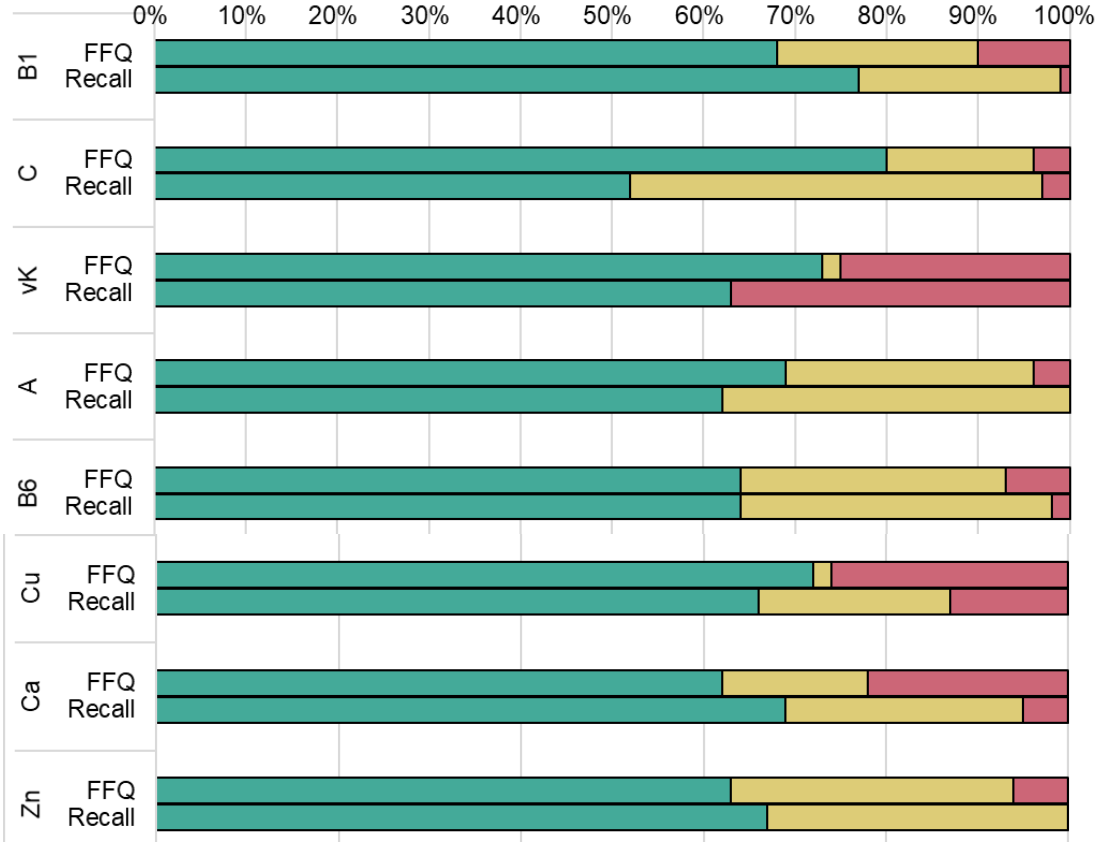
- Despite use of different methodologies and nutrient databases across cohorts and over time, food-based results were similar between methodologies (±10%) for most nutrients, including directionality in disparity analyses.
- Results with dietary supplements varied more between methodologies, but sample sizes varied across analyses

Risk of inadequate intake

% not at risk

% at risk without supplements

% at risk with supplements



Harmonization of methods to measure total energy intake

Reported energy intake with the ASA24 was 231 kcal higher than the EER.
Reported energy intake with the RFPM did not differ significantly from the EER.

	Overall		Girls		Boys	
Predicted means						
	Mean (SE)		Mean (SE)		Mean (SE)	
ASA24	1675 (70)		1541 (91)		1809 (105)	
RFPM	1296 (77)		1351 (102)		1241 (116)	
EER	1444 (34)		1361 (46)		1526 (50)	
Predicted differences						
	Difference (95% CI)	p	Difference (95% CI)	p	Difference (95% CI)	p
ASA24 – RFPM	379 (194, 564)	0.0002	190 (-51, 432)	0.12	567 (287, 848)	0.0002
ASA24 - EER	231 (63, 400)	0.008	179 (-44, 403)	0.11	283 (31, 536)	0.03
RFPM - EER	-148 (-321, 26)	0.09	-11 (-240, 218)	0.92	-284 (-545, -24)	0.03

Final thoughts

- Document harmonization methods essential for transparency
- Apply tests of heterogeneity to identify factors that may have an effect on diet outcome of interest
  - Stratify analyses if appropriate
- Trade-offs between limiting analyses to single measurement method vs. harmonizing that relate to generalizability (selection bias), measurement error bias, and power
  - Apply sensitivity analyses!!
  - Simple consideration is leave-one-out analyses (by measurement method) - beneficial to understand the potential impact on the overall findings
- Analysis methods must account for between-study heterogeneity