

Approaches to Dietary Pattern Analyses: Potential to Inform Guidance

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Outline

- What do we mean by dietary patterns, and why are we interested?
- What are the primary methods for studying dietary patterns, and what questions do they address?
- How do methodological considerations affect results?
- What questions, if answered, could inform guidance?
- Challenges ahead

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Introduction, definitions

Definition of dietary patterns

- The quantities, proportions, variety or combination of different foods, drinks, and nutrients in diets, and the frequency with which they are habitually consumed*

Definition of dietary patterns

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Definition of dietary patterns

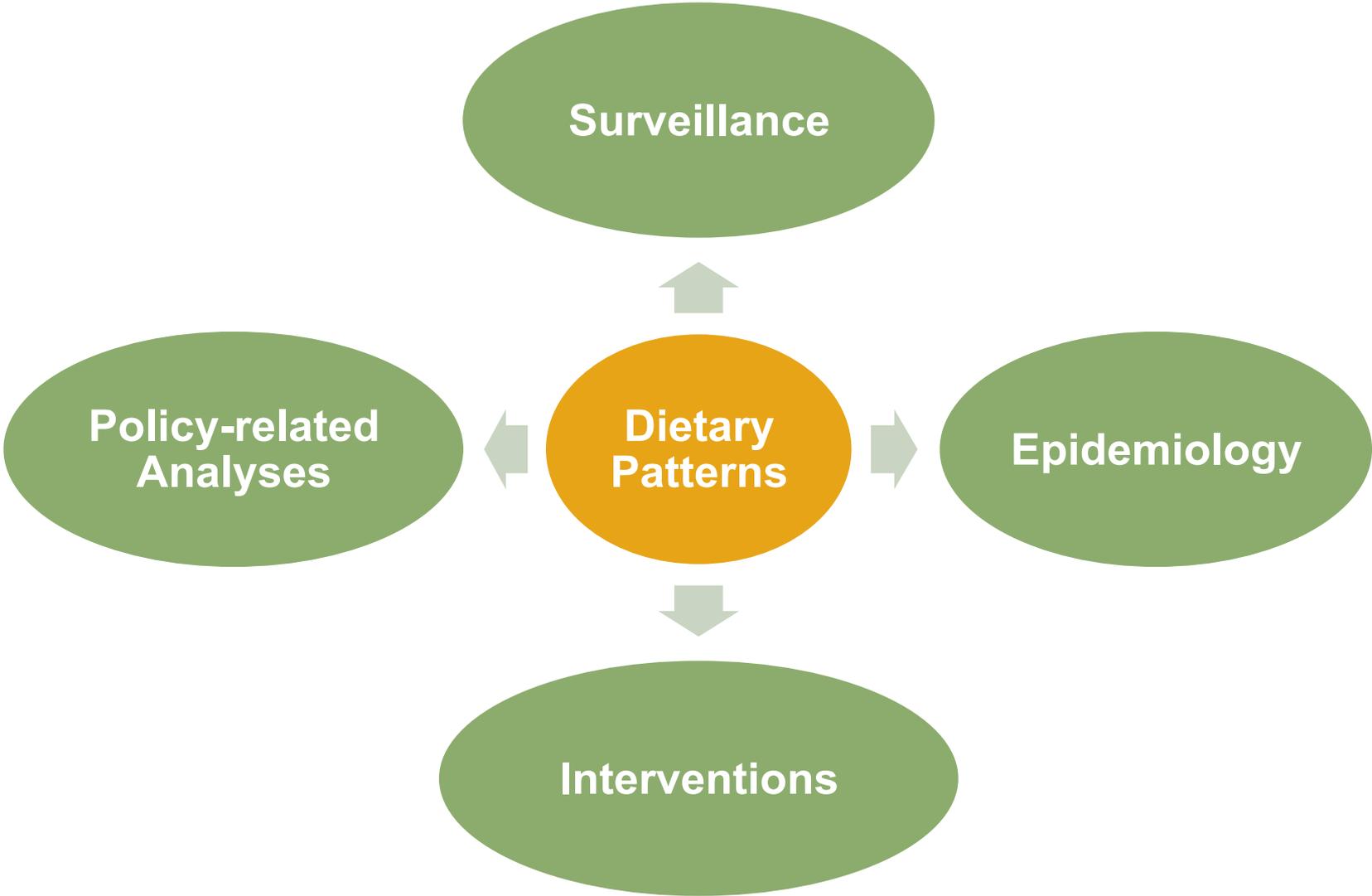
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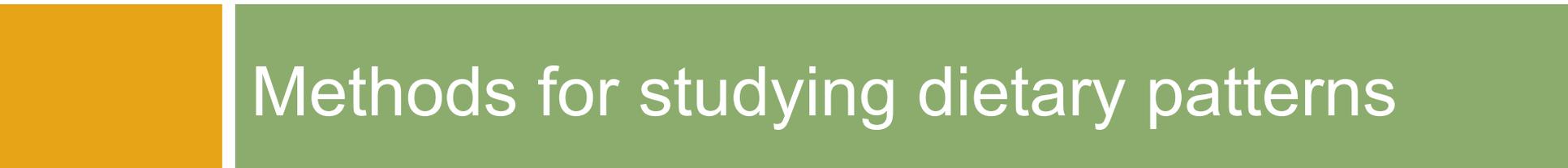
Definition of dietary patterns

- The quantities, proportions, variety or combination of different foods, drinks, and nutrients in diets, and the frequency with which they are **habitually consumed***

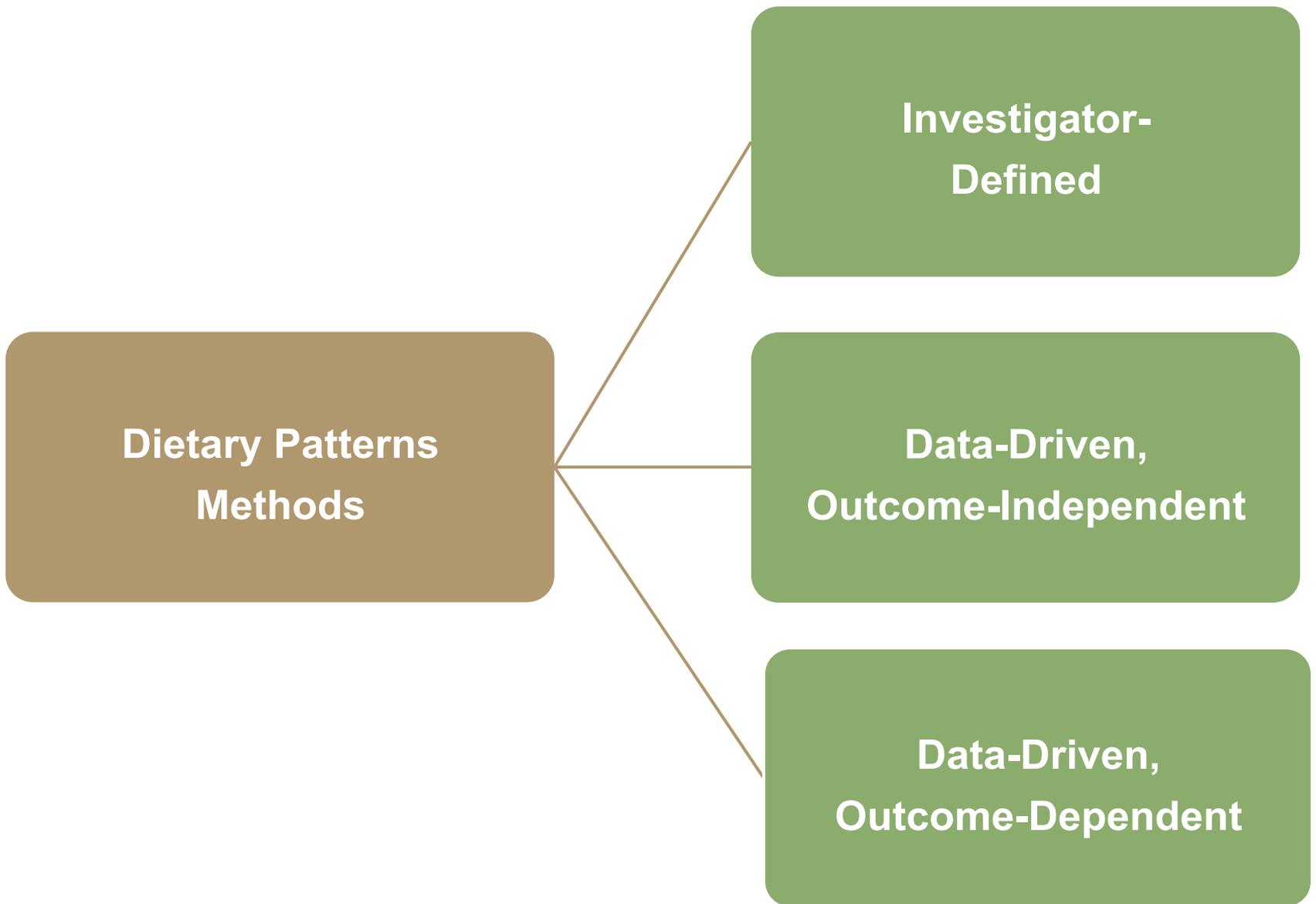
Why study dietary patterns?

- Complexity of diet
- Correlation among dietary constituents
- Evidence for positive health outcomes with changes in “total diet”
- Relevance for policy and guidance



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Methods for studying dietary patterns





Selective Diets (e.g., *Vegetarian*)

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Are you a
vegetarian?

Selective Diets (e.g., *Vegetarian*)

Are you a
vegetarian?



Yes!

Selective Diets (e.g., Vegetarian)

Are you a vegetarian?



Yes!

Exclude

- Meat
- Fish
- Poultry
- (Eggs)
- (Milk)

Include

- Fruits?
- Vegetables?
- Whole grains?
- Refined grains?
- Added sugars?
- Solid fats?

Indexes/Scores

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How close is the population to meeting a set of dietary recommendations?

Indexes/Scores

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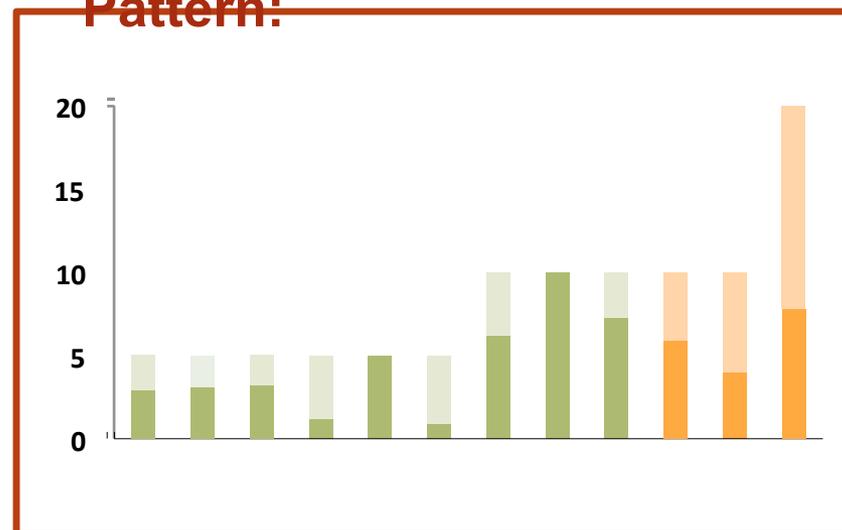
**Overall Diet Quality:
Total score = 58/100**

Indexes/Scores

How close is the population to meeting a set of dietary recommendations?

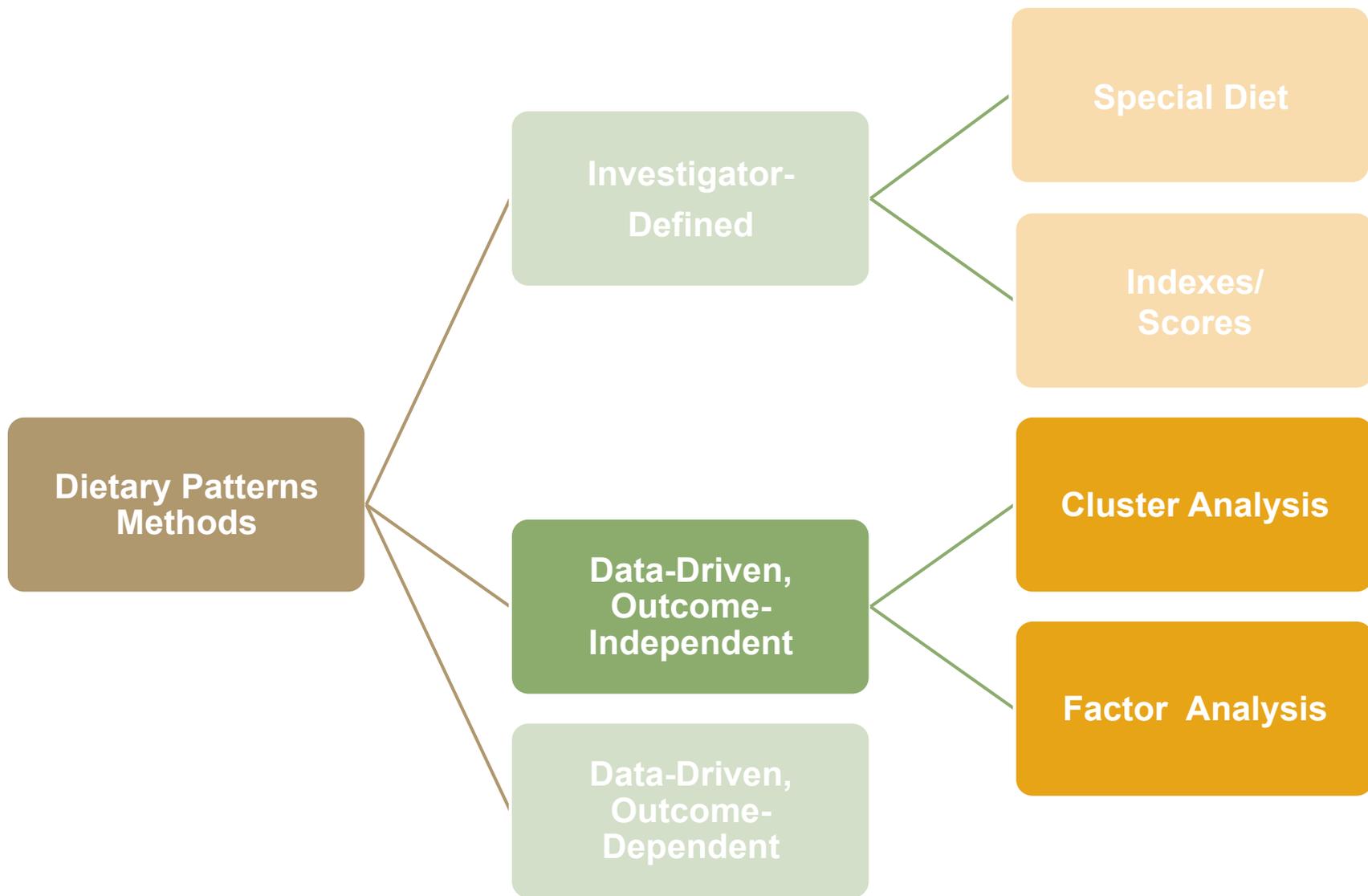
**Overall Diet Quality:
Total score = 58/100**

Pattern:



Indexes/Scores

- Characterize the total diet
- Intuitively appealing and *relatively* simple to compute
- Results are interpretable
- Reproducible across studies
- Scoring algorithms affect results



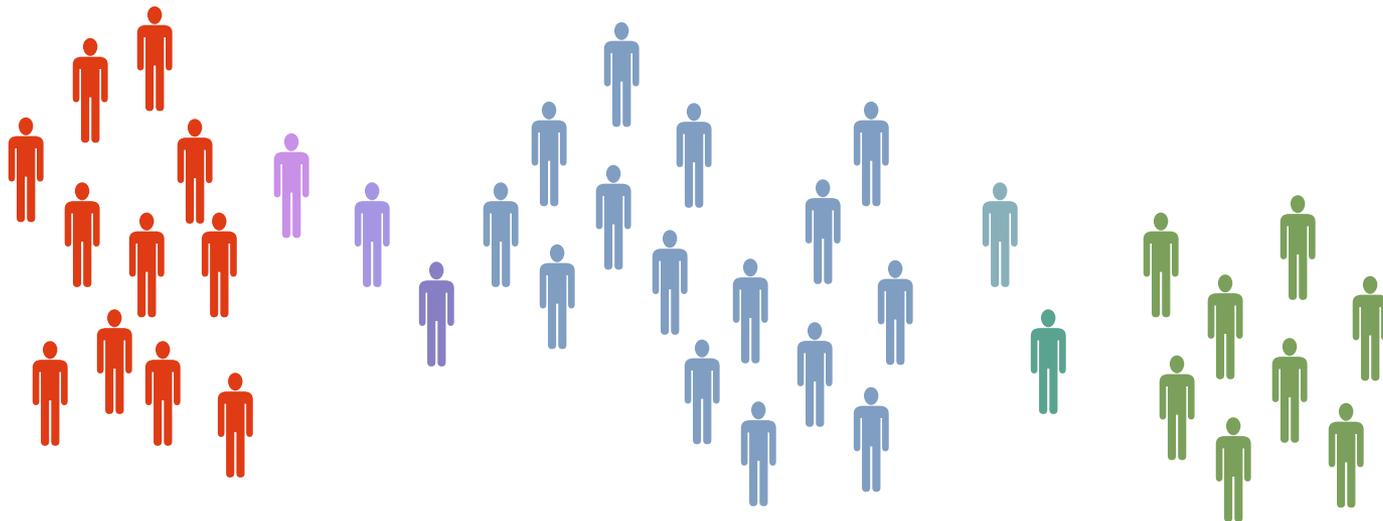
Cluster Analysis

Cluster Analysis

Are there groups of people with distinct eating patterns?

Cluster Analysis

Are there groups of people with distinct eating patterns?



Groups **people** according to their dietary patterns

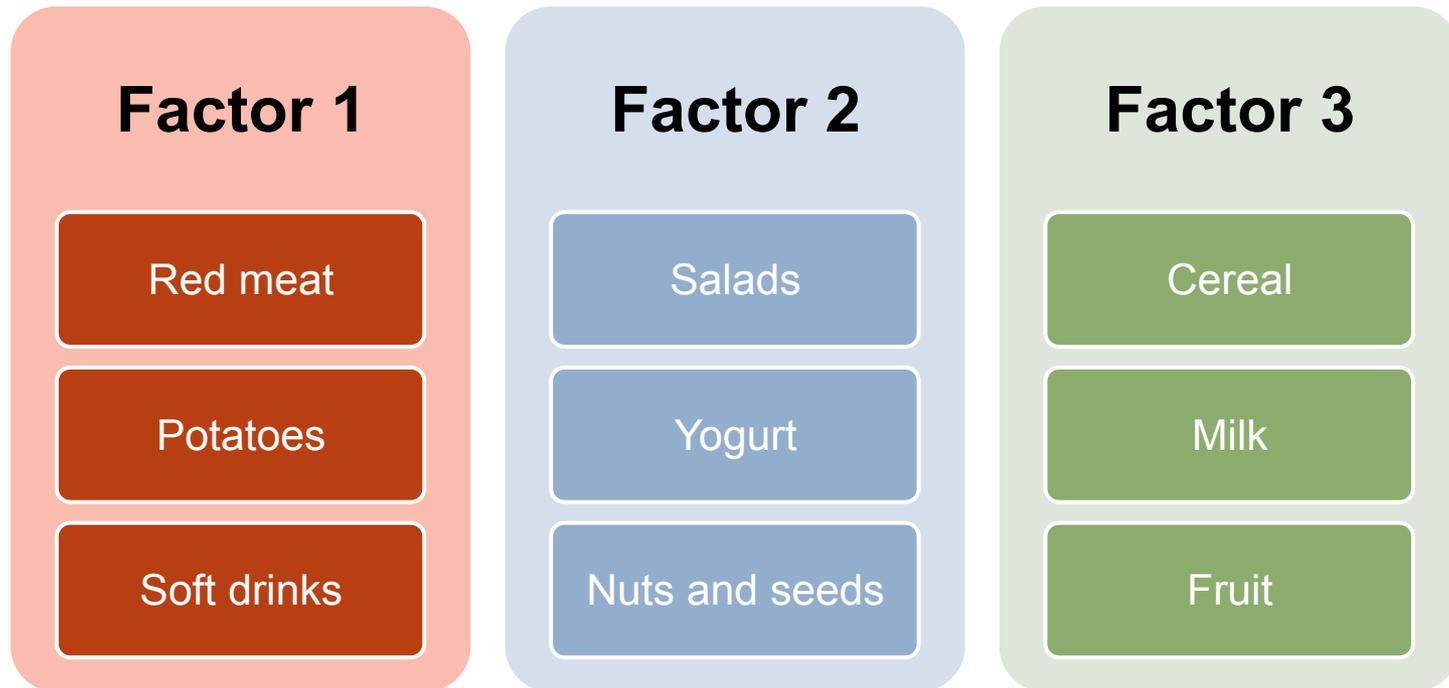
Factor Analysis

Factor Analysis

What elements of the diet track together in explaining variation in diets?

Factor Analysis

What elements of the diet track together in explaining variation in diets?



Identifies **elements of the diet** that track together

Cluster Analysis

Factor Analysis

- Characterize the total diet
- Results are interpretable
- Limited reproducibility across studies

Selective Diets

- People who meet/don't meet criteria

Indexes/ Scores

- Individuals' scores on quality and its components

Cluster Analysis

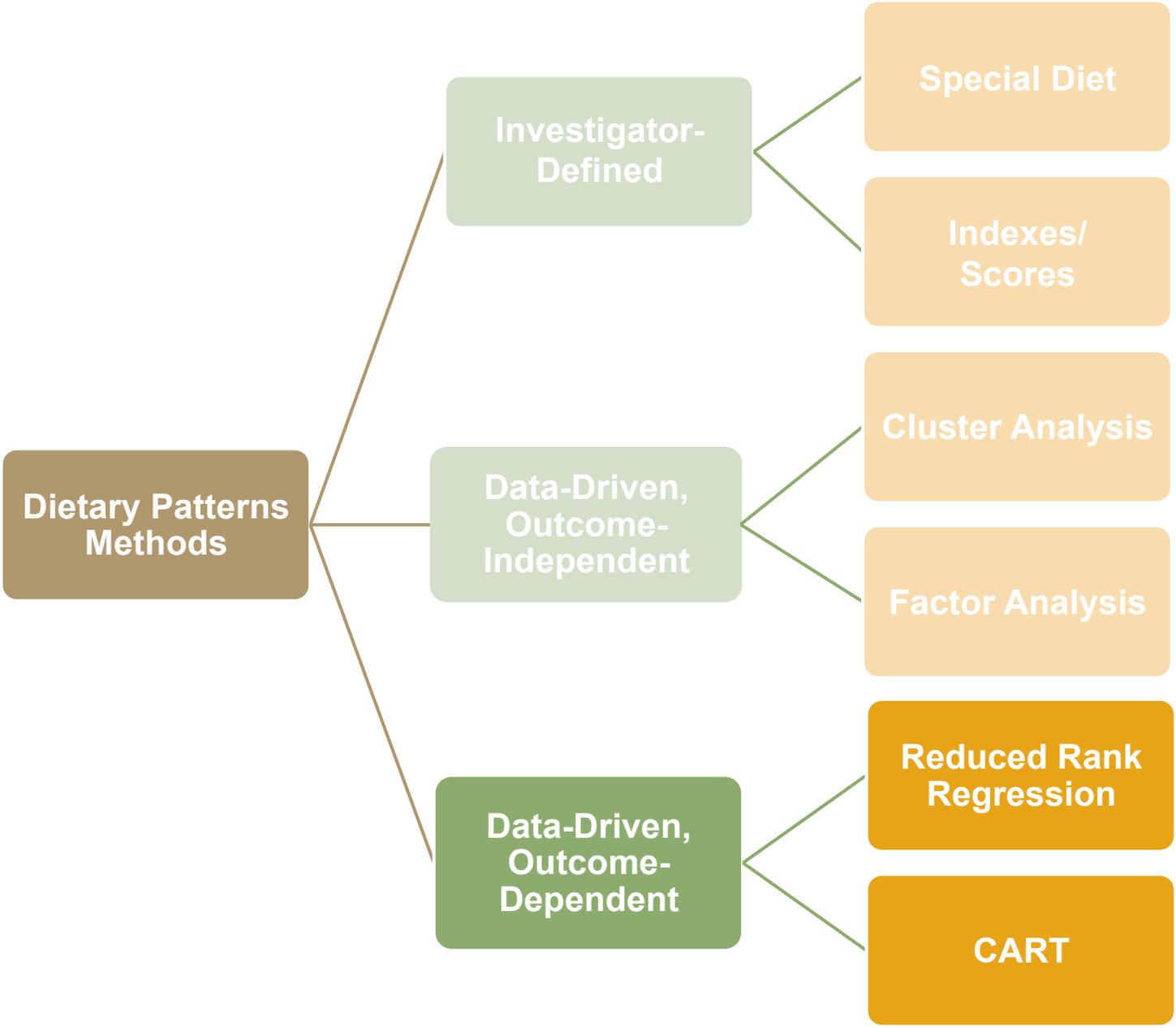
- Groups of individuals and their diet patterns

Factor Analysis

- Factors explaining variation in individuals' scores

Hypothesis Testing

How do dietary patterns relate to health outcome?



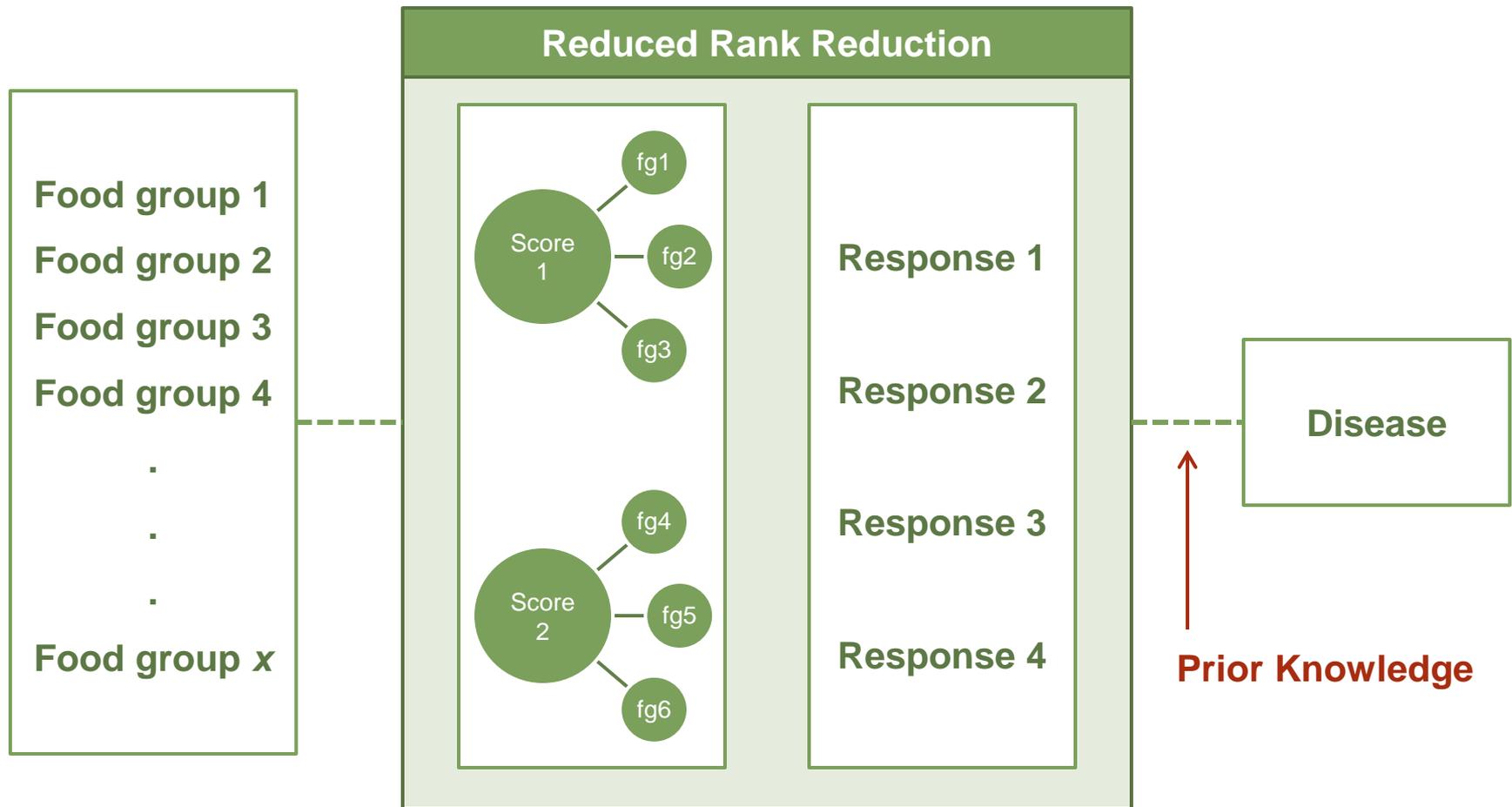
Reduced Rank Regression

Reduced Rank Regression

What combination of foods explains the most variation in a set of intermediate health markers?

Reduced Rank Regression

What combination of foods explains the most variation in a set of intermediate health markers?



CART

CART

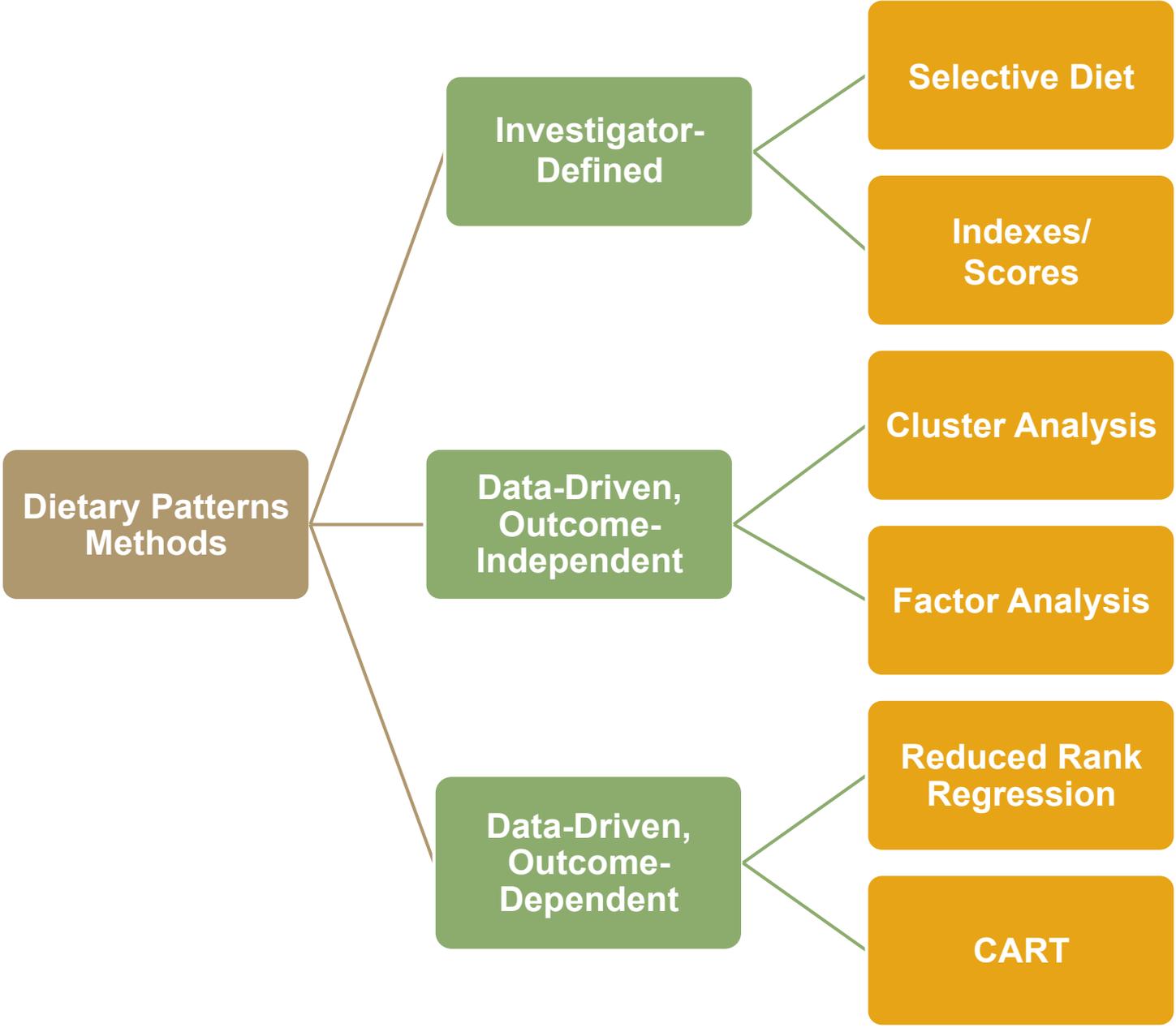
What dietary components explain the most variation in a health outcome?

CART

What dietary components explain the most variation in a health outcome?



Hypothetical example of CART results



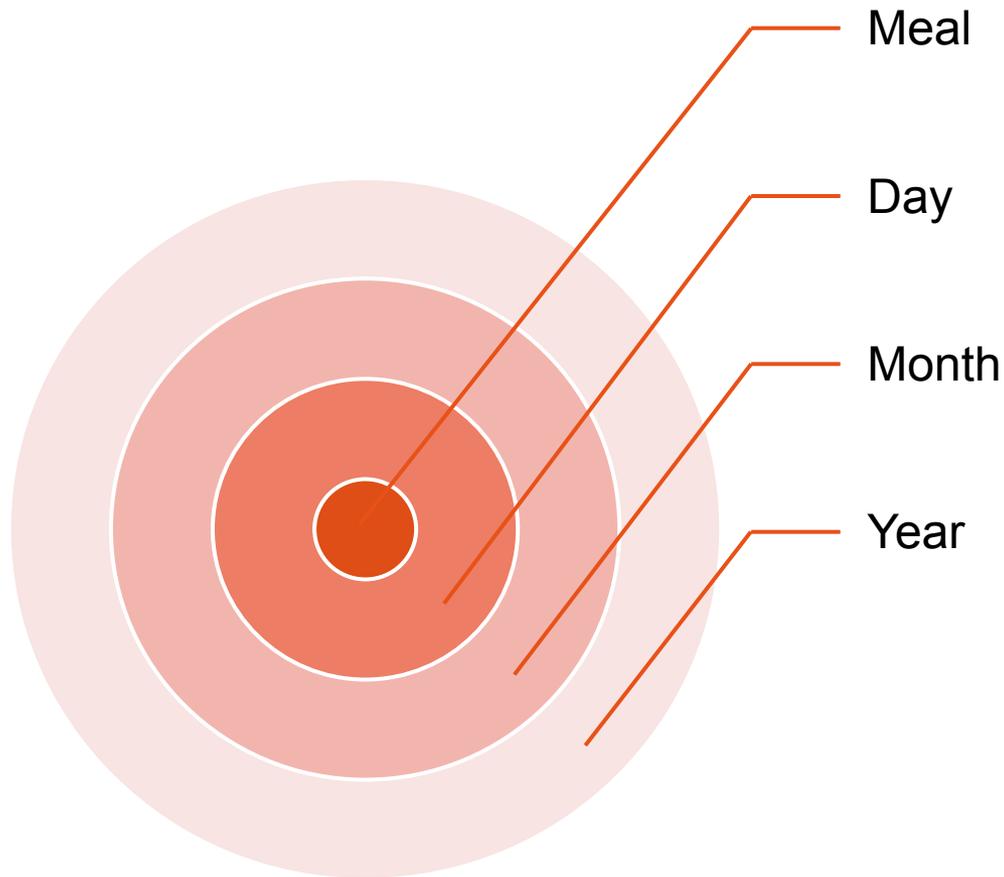


Methodological considerations

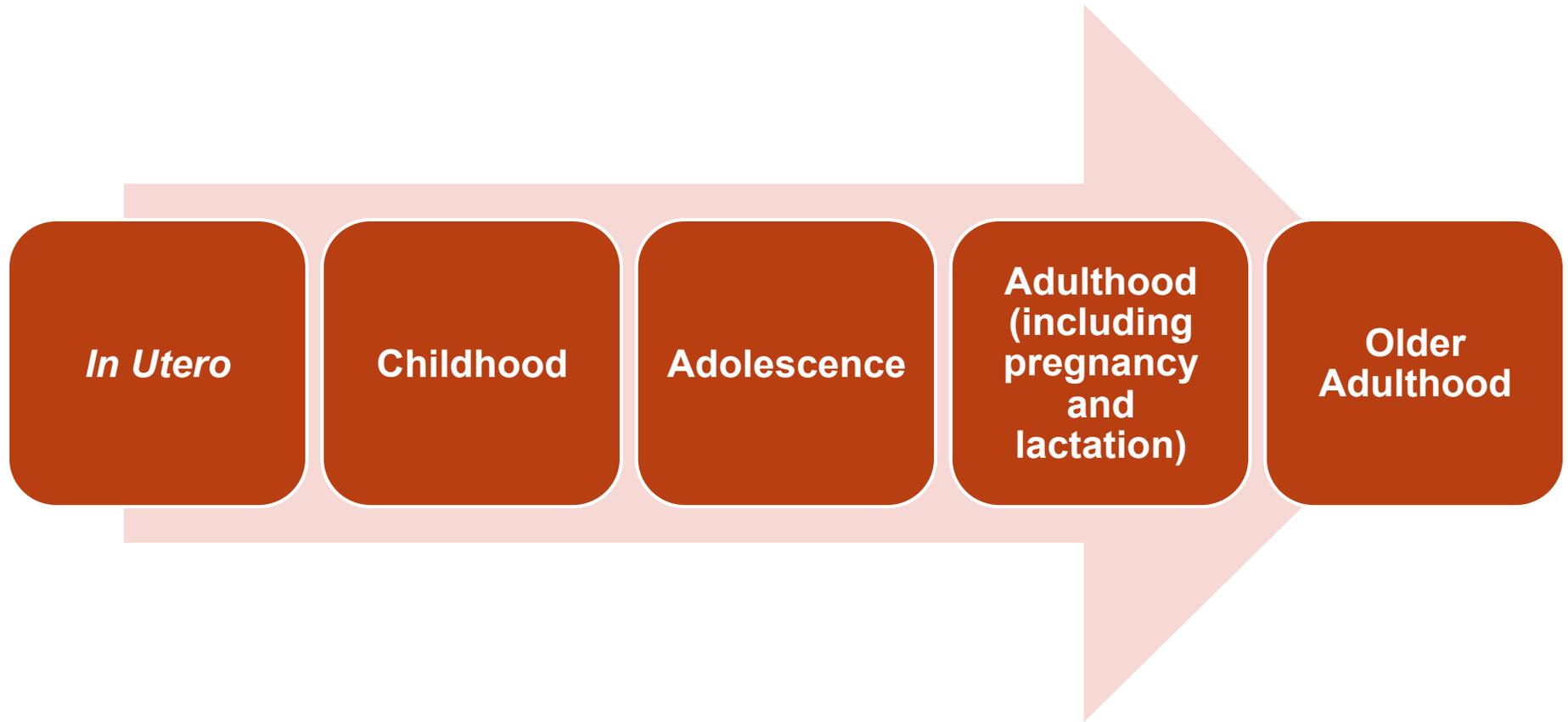
Data collection method

- Food frequency questionnaires
 - ▶ Represent long-range intake
 - ▶ Cognitively difficult, so accuracy is diminished
 - ▶ Traditionally, only affordable method for large-scale studies
- 24-hour recalls
 - ▶ Represent short-term intake
 - ▶ Requires modeling to estimate usual intake
 - ▶ Captures details
 - ▶ New tools make them affordable

Time frame of reference



Diet over the life course



In Utero

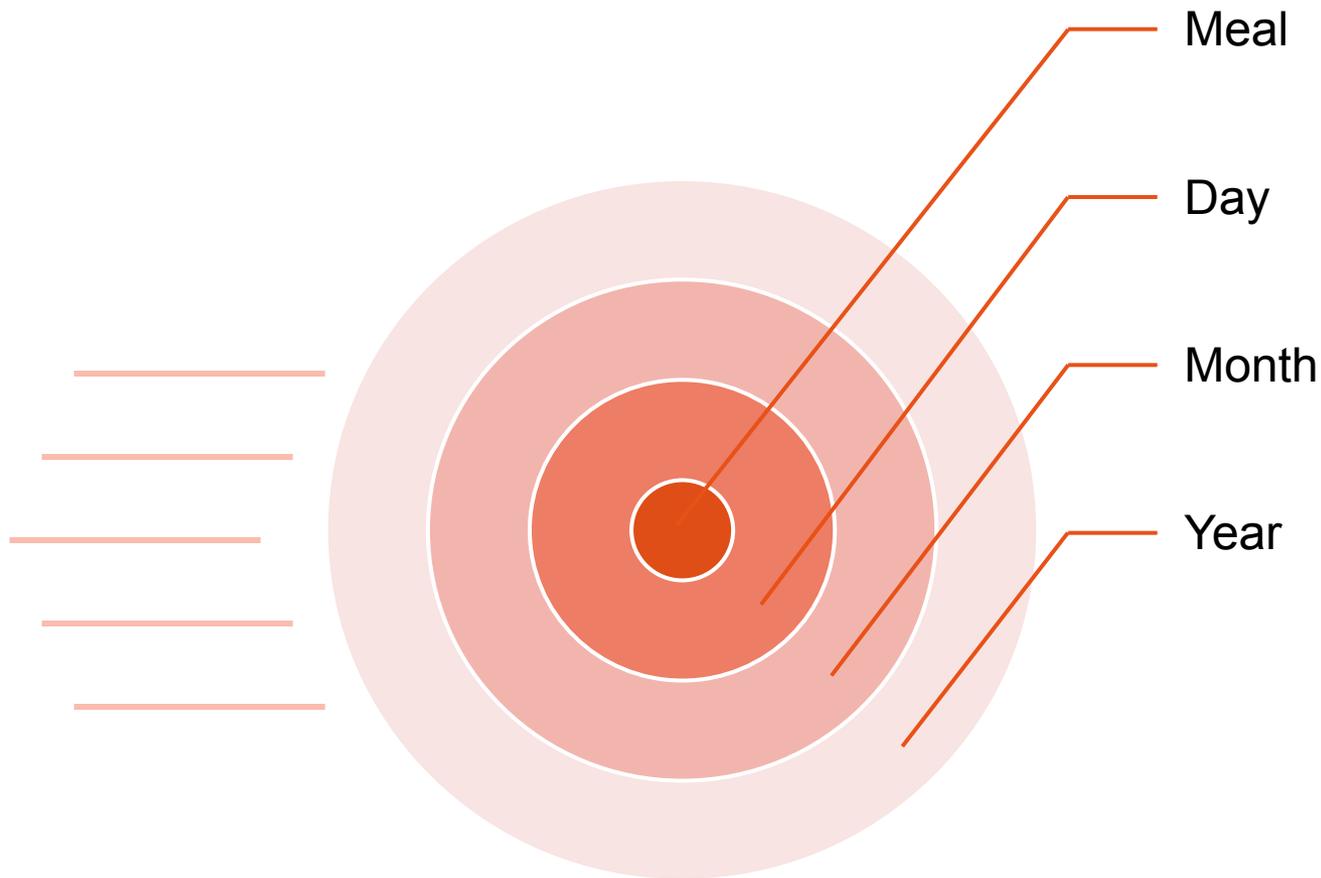
Childhood

Adolescence

Adulthood
(including
pregnancy
and
lactation)

Older
Adulthood

Diet as dynamic exposure



In utero

Childhood

Adolescence

Adulthood

Older Adulthood

New technologies



Offer capability to capture streams of data

Food categories or food groups?

Food categories

- Pasta dishes
- Macaroni and cheese
- Burritos, tacos
- Stir-fry mixtures
- Pizza
- Cereal, high sugar
- Cereal, low sugar
- Lettuce salads
- Etc.

Food groups

- Whole fruit
- Fruit juice
- Whole grain
- Refined grain
- Hi-omega 3 fish
- Low-omega 3 fish
- Added sugars
- Solid fats
- Etc.

**Food as eaten
(Food Categories)**

Sandwich

Ingredients

Bread, whole grain

Cheese

Ham

**Food Patterns
Equivalents
Database (FPED)
(Food Groups)**

Whole grain
equivalents

Dairy
equivalents

Lean meat
equivalents

Solid fat grams

Solid fat grams

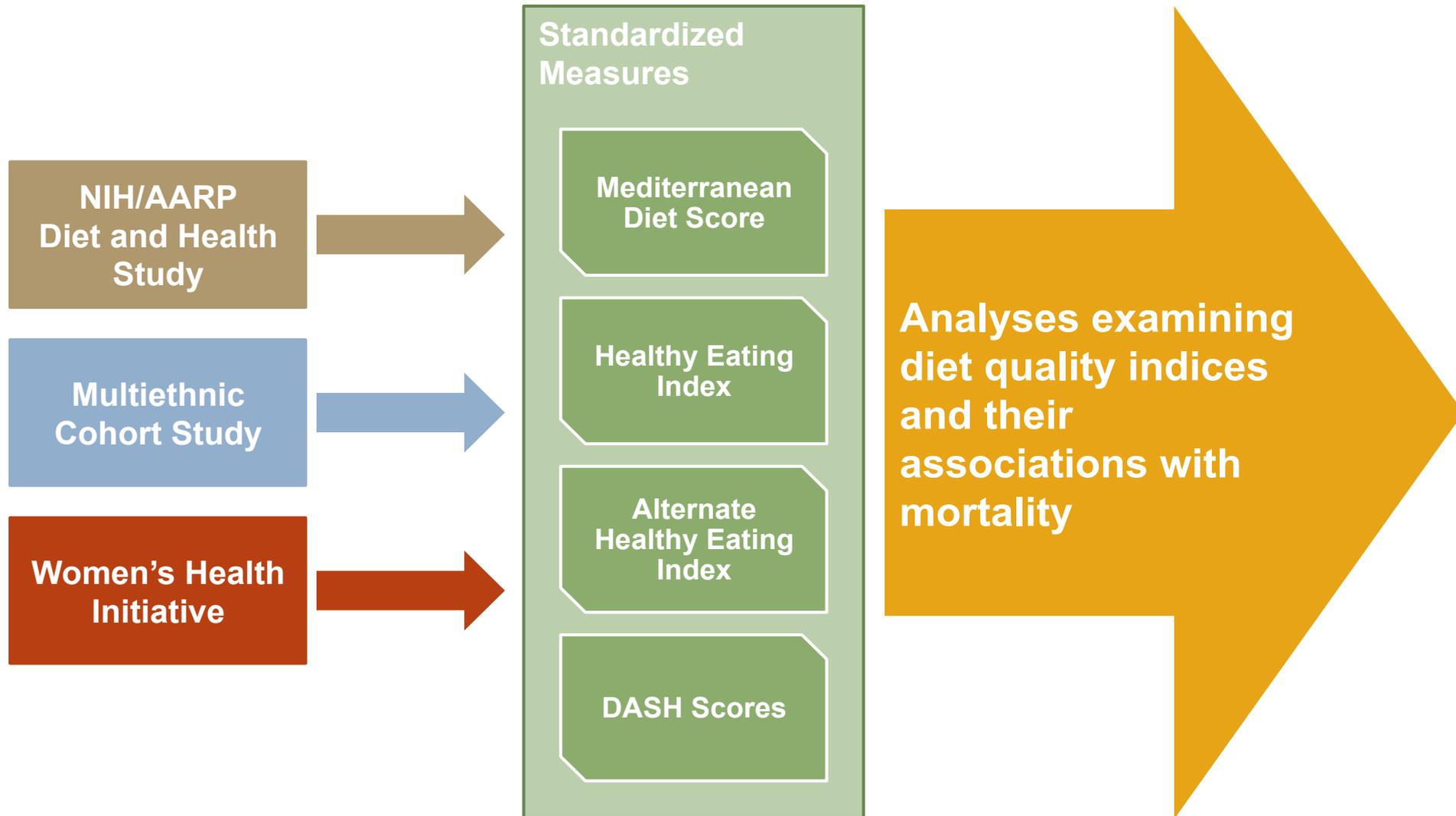
Subjectivity

- Choice of variables
- Treatment of input variables
- Labeling of patterns
- Scoring algorithms
 - ▶ Determination of min/max
 - ▶ Truncation
 - ▶ Weighting to derive total score

Population being examined

- Data-driven methods may not derive comparable patterns in different populations
- Investigator-driven methods will always identify patterns in same way, although prevalences will vary among populations
- Many cohort studies, each with different populations, have used different indices/scores

Dietary Patterns Methods Project





Questions to inform guidance

Questions posed by major methods

- Who are the vegetarians, ...
- How close is the population to meeting recommendation on key aspects of diet, ...
- What dietary patterns are shown by the population, ...
 - ▶ ... and how do those patterns relate to health outcome?
- Which dietary patterns are most predictive of health outcome?

Additional questions worth examining

- Who is and is not following recommendations, and what are the patterns of deviation?
- Among vegetarians (or pregnant women or any other group), what are patterns of eating relative to recommendations, and what foods as-eaten characterize those patterns?
- What combinations of food groups, and in what quantities, would be needed to achieve nutritional adequacy while avoiding excessive intakes of deleterious dietary components, within the context of typical dietary choices?

Future research questions

- What combinations of food intake explain the most variation in a specific health outcome?
- What are the patterns upstream?
- How else can we characterize patterns (beyond what is eaten)?
- How can we examine diet as a dynamic exposure?

What are the patterns upstream ?



Food supply

Market/Community

Individual

Characterizing dietary patterns at multiple levels



Food Supply



Market



Individual

Posing questions at different levels

How close is the population to meeting dietary recommendations?



Individual

Posing questions at different levels

How do menus at top fast food restaurants compare with recommendations?

How close is the population to meeting dietary recommendations?



Market



Individual

Posing questions at different levels

Does the food supply align with current dietary recommendations?



Food Supply

How do menus at top fast food restaurants compare with recommendations?



Market

How close is the population to meeting dietary recommendations?



Individual

Characterizing dietary patterns at multiple levels



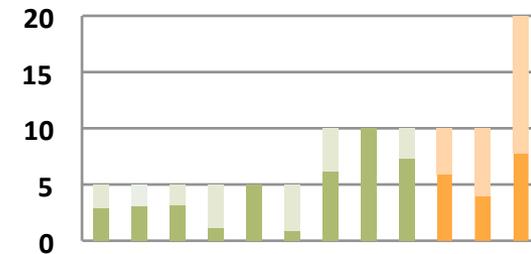
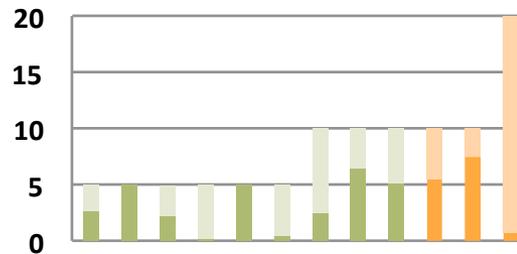
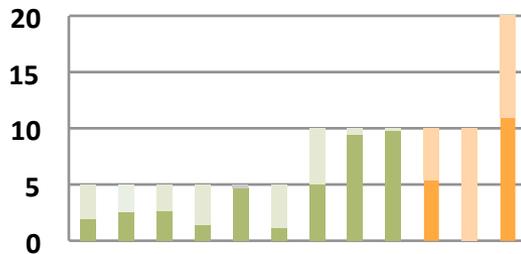
Food Supply



Market



Individual

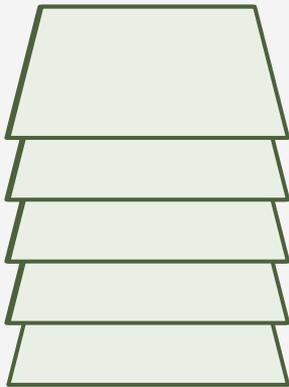


Expanding the definition

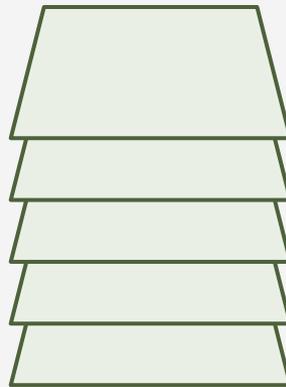
- The **qualities**, quantities, proportions, variety or combination of different foods, drinks, and nutrients in diets, and the **timing, location** and frequency with which they are habitually consumed

Moving beyond what is eaten: adding layers

Food supply

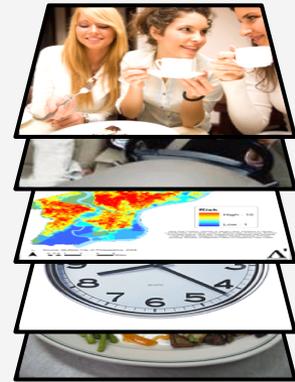


Market/Community

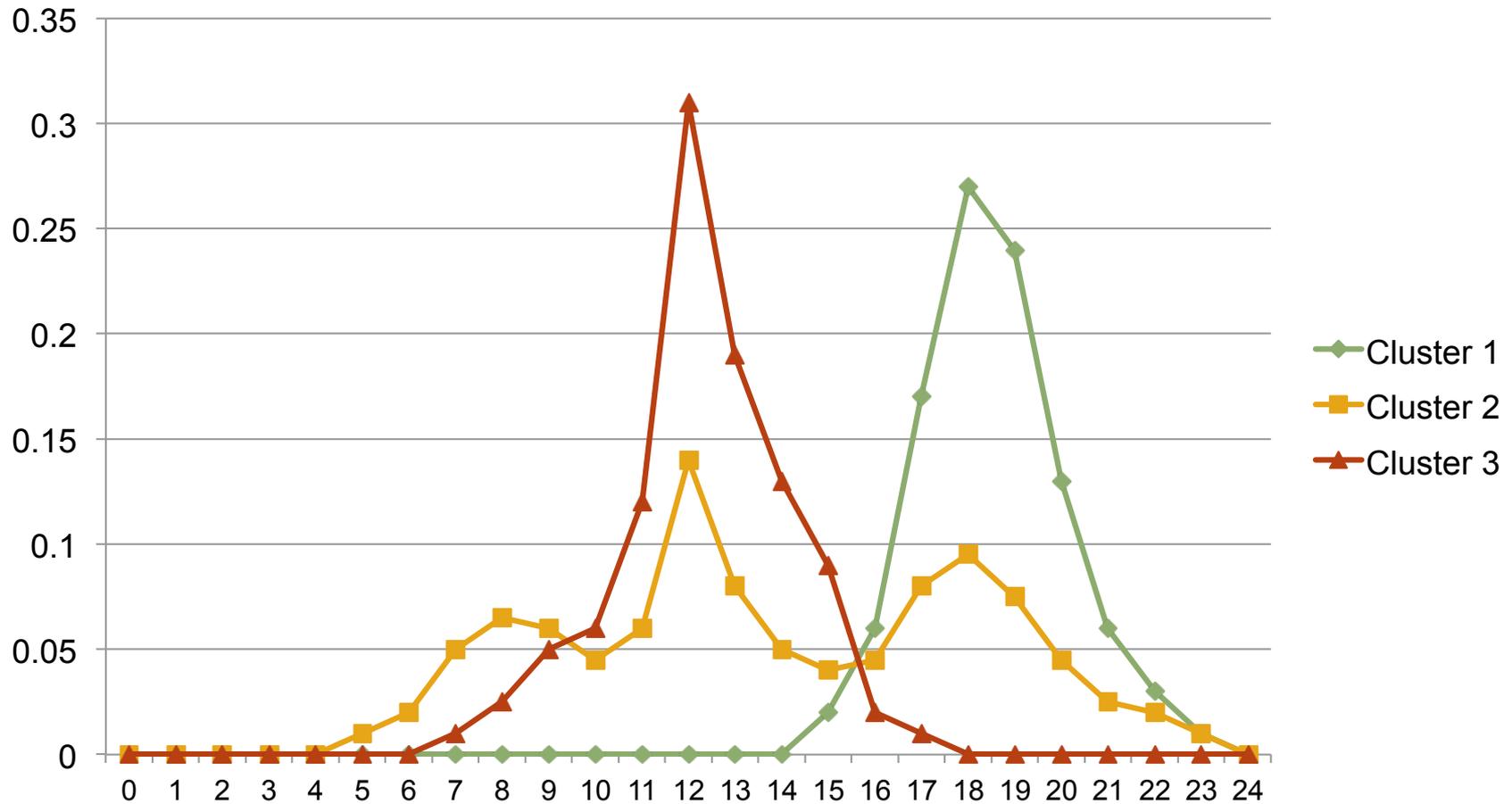


Individual

How
Why
Where
When
What



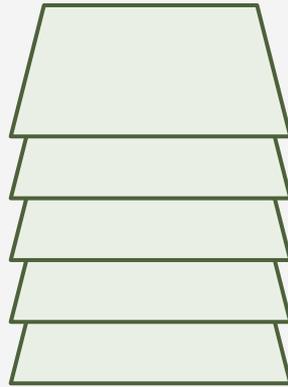
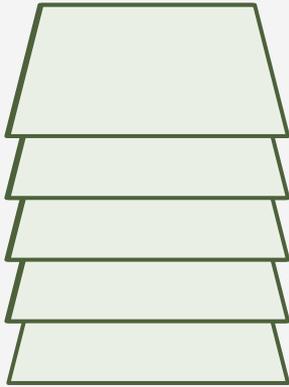
Temporal eating patterns



Food supply

Market/Community

Individual



Meal

Day

Month

Year

In utero

Childhood

Adolescence

Adulthood

Old Age



Final thoughts

Future challenges

- Methods of data capture and analysis to handle streams of data
- Continued refinement of indices
- Standardization of input variables and algorithms, harmonization of methods
- Learning from other disciplines to address additional questions

Bottom line

- Match methods and measures to questions of interest

What are your questions?