Dietary patterns vs. health status
What are dietary patterns?

Links to health

Future opportunity
## Mortality rates in different populations

<table>
<thead>
<tr>
<th>Rank</th>
<th>Location</th>
<th>Life Expectancy</th>
<th>Eating Pattern</th>
<th>CHD</th>
<th>Cancer</th>
<th>Stroke</th>
<th>All Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Okinawa</td>
<td>81.2</td>
<td>East-West</td>
<td>18</td>
<td>97</td>
<td>35</td>
<td>335</td>
</tr>
<tr>
<td>2</td>
<td>Japan</td>
<td>79.9</td>
<td>Asian</td>
<td>22</td>
<td>106</td>
<td>45</td>
<td>364</td>
</tr>
<tr>
<td>3</td>
<td>Hong Kong</td>
<td>79.1</td>
<td>Asian</td>
<td>40</td>
<td>126</td>
<td>40</td>
<td>393</td>
</tr>
<tr>
<td>4</td>
<td>Sweden</td>
<td>79.0</td>
<td>Nordic</td>
<td>102</td>
<td>108</td>
<td>38</td>
<td>435</td>
</tr>
<tr>
<td>8</td>
<td>Italy</td>
<td>78.3</td>
<td>Mediterranean</td>
<td>55</td>
<td>135</td>
<td>49</td>
<td>459</td>
</tr>
<tr>
<td>10</td>
<td>Greece</td>
<td>78.1</td>
<td>Mediterranean</td>
<td>55</td>
<td>109</td>
<td>70</td>
<td>449</td>
</tr>
<tr>
<td>18</td>
<td>USA</td>
<td>76.8</td>
<td>American</td>
<td>100</td>
<td>132</td>
<td>28</td>
<td>520</td>
</tr>
</tbody>
</table>

* Average life expectancy world rank

Why dietary patterns?

Human diet is complex – we do not eat nutrients or foods in isolation.

- Patterns from **total diet** may help unravel diet-health relationships better than single food/nutrient studies (frequently null eg. fat intake & obesity).

- Overcomes strong **co-linearity** between diet variables; difficult to separate.

- **Avoids multiple testing** of many nutrients which increases probability of chance findings.

  - **BUT** tools used to measure patterns eg. FFQ, 24h recall are self-reported with bias.

  - **Definitions vary and may not be comparable.**
Consumer understanding of dietary patterns

- Consumers have poor understanding of how a ‘healthy diet’ relates to their intakes
- Low SES = risk factor for not adhering to healthy diet
- Intentions, habits, self-regulatory skills, social/physical environment - determinants of a healthy diet, which may be amenable to change by interventions

Systematic review of psychology literature on healthy diet
(de Ridder at al, Psychology & Health, 2017)
Defining dietary patterns

Methods to derive dietary patterns

Hypothesis-oriented approach (use of prior information)
- Indexes and scores

Exploratory approach (use of study-specific data)
- Reduced rank regression
- Principal component analysis or factor analysis
- Cluster analysis

Simplified dietary patterns:
- ‘Snacks, fast food and fizzy drinks’
- ‘Fruit, veg and oily fish’
- ‘Processed meat and potatoes’
- ‘Sugary foods and dairy’
1. Hypothesis – oriented patterns

Patterns determined *a priori* by the investigator

Use a score-based approach. Eg.

- adherence to dietary guidelines
- adherence the characteristics of a culturally/regionally defined eating pattern

Commonly used diet scores for adherence to recommendations:

- The Healthy Eating Index (HEI), Alternate Healthy Eating Index (AHEI), and Dietary Approaches to Stop Hypertension (DASH) score
- The Mediterranean Diet Score
68 studies, >1.5m participants.

High v. low quality diet lower risk:

• All-cause mortality by 22%
• CVD by 22%
• Cancer by 16%
• Type 2 diabetes by 18%
• Neurodegenerative disease by 15%
Highest v. lowest diet quality for cancer mortality in *cancer survivors*.

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Weight</th>
<th>Risk Ratio IV, Random, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>George and colleagues 2011</td>
<td>0.2%</td>
<td>0.12 [0.01, 0.99]</td>
</tr>
<tr>
<td>George and colleagues 2014</td>
<td>4.1%</td>
<td>0.91 [0.60, 1.38]</td>
</tr>
<tr>
<td>Jacobs and colleagues 2016 M</td>
<td>11.0%</td>
<td>0.85 [0.66, 1.09]</td>
</tr>
<tr>
<td>Jacobs and colleagues 2016 W</td>
<td>9.7%</td>
<td>0.76 [0.58, 1.00]</td>
</tr>
<tr>
<td>Pelser and colleagues 2014</td>
<td>11.2%</td>
<td>0.99 [0.77, 1.27]</td>
</tr>
<tr>
<td>Thomson and colleagues 2014</td>
<td>7.3%</td>
<td>0.75 [0.55, 1.02]</td>
</tr>
<tr>
<td><strong>Subtotal (95% CI)</strong></td>
<td>43.5%</td>
<td><strong>0.84 [0.73, 0.97]</strong></td>
</tr>
</tbody>
</table>

Heterogeneity: $\tau^2 = 0.01$; $\chi^2 = 6.09$, df = 5 ($P = 0.30$); $I^2 = 18\%$

Test for overall effect: $Z = 2.34$ ($P = 0.02$)
If dietary pattern is adopted does this affect health?
After 4.8 y, 288 major CVD events occurred in 7447 participants.
Cohorts: lower risk of death for increase in adherence to Mediterranean diet.
Sofi et al, BMJ 2008

Fig 2: Risk of all cause mortality associated with two point increase in adherence score for Mediterranean diet. Squares represent effect size; extended lines show 95% confidence intervals; diamond represents total effect size.
The Mediterranean diet and risk of colorectal cancer in the UK Women’s Cohort Study

Petra Jones,¹,²,* Janet E Cade,¹ Charlotte E.L. Evans,¹ Neil Hancock,¹ and Darren C. Greenwood¹,³

Figure 1. Restricted cubic splines for the association between (a) colorectal, (b) colon and (c) rectal cancer and the Mediterranean diet (MD) score. Hazard ratios estimated using a Cox proportional hazards model, adjusted for age, body mass index, energy intake, smoking and socioeconomic status. Bars indicate 95% confidence intervals derived from 3-knot restricted cubic spline regression.
2. Exploratory approach – data driven:

Eg. Principal components analysis (PCA), factor analysis and cluster analysis.

✓ **Data reduction** techniques; identify latent constructs = patterns

✓ Takes advantage of **co-linearity**

✓ Considers total diet; ‘real life’ consumption and synergism

✓ Patterns are **uncorrelated** suitable for multivariate models
  - *Study specific, may not be reproducible in different populations*
  - *Explains variation in foods but not necessarily nutrients*
  - *Not disease specific or hypothesis based*
Empirical diet patterns from UK NDNS - PCA

4 main patterns identified…..

<table>
<thead>
<tr>
<th>Significant positive Associations (p&lt;0.05)</th>
<th>Sample characteristics and lifestyle factors*</th>
<th>‘Snacks, fast food and fizzy drinks’</th>
<th>‘Fruit, veg and oily fish’</th>
<th>‘Processed meat and potatoes’</th>
<th>‘Sugary foods and dairy’</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• BMI</td>
<td>• Age</td>
<td>• Age</td>
<td>• Age</td>
<td>• Age</td>
</tr>
<tr>
<td></td>
<td>• Smoker</td>
<td>• Household income</td>
<td>• Male gender</td>
<td>• White ethnicity</td>
<td>• White ethnicity</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Smoker</td>
<td>• Lower supervisory and Semi-routine occupations</td>
</tr>
</tbody>
</table>

Roberts et al, Nutrients 2018, 10, 177;
Studies using PCA or factor analysis:

highest v. lowest Western diet and breast cancer


<table>
<thead>
<tr>
<th>ID</th>
<th>RR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terry et al (2001)</td>
<td>1.00 (0.79, 1.26)</td>
</tr>
<tr>
<td>Sieri et al (2004)</td>
<td>0.90 (0.58, 1.40)</td>
</tr>
<tr>
<td>Adebamowo et al (2005)</td>
<td>0.97 (0.71, 1.33)</td>
</tr>
<tr>
<td>Fung et al (2005)</td>
<td>1.18 (0.77, 1.81)</td>
</tr>
<tr>
<td>Männisto et al (2005)</td>
<td>0.69 (0.52, 0.92)</td>
</tr>
<tr>
<td>Männisto et al (2005)</td>
<td>1.07 (0.58, 1.98)</td>
</tr>
<tr>
<td>Männisto et al (2005)</td>
<td>0.92 (0.78, 1.09)</td>
</tr>
<tr>
<td>Velie et al (2005)</td>
<td>1.03 (0.89, 1.20)</td>
</tr>
<tr>
<td>Sant et al (2007)</td>
<td>0.75 (0.27, 2.08)</td>
</tr>
<tr>
<td>Cottet et al (2009)</td>
<td>1.20 (1.04, 1.39)</td>
</tr>
<tr>
<td>Agurs-Collins et al (2009)</td>
<td>1.06 (0.82, 1.38)</td>
</tr>
<tr>
<td>Baglietto et al (2011)</td>
<td>1.12 (0.85, 1.47)</td>
</tr>
</tbody>
</table>
## Survival Analysis of 7 clusters and breast cancer: UKWCS

<table>
<thead>
<tr>
<th>Diet Category</th>
<th>Premenopausal</th>
<th>Postmenopausal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Higher diversity traditional omnivores</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Traditional meat, chips and pudding eaters</td>
<td>1.63 (0.98, 2.71)</td>
<td>0.85 (0.56, 1.30)</td>
</tr>
<tr>
<td>Conservative omnivores</td>
<td>1.72 (0.99, 2.98)</td>
<td>1.35 (0.89, 2.04)</td>
</tr>
<tr>
<td>Monotonous low quantity omnivores</td>
<td>1.35 (0.73, 2.51)</td>
<td>1.22 (0.75, 1.97)</td>
</tr>
<tr>
<td>Health Conscious</td>
<td>0.98 (0.44, 2.19)</td>
<td>0.72 (0.39, 1.32)</td>
</tr>
<tr>
<td>Low diversity vegetarians</td>
<td>1.09 (0.62, 1.93)</td>
<td>0.92 (0.54, 1.56)</td>
</tr>
<tr>
<td>High diversity vegetarians</td>
<td>1.28 (0.75, 2.21)</td>
<td><strong>0.59 (0.32, 1.08)</strong></td>
</tr>
<tr>
<td>Test between groups</td>
<td><strong>0.256</strong></td>
<td><strong>0.084</strong></td>
</tr>
</tbody>
</table>
Prudent/healthy diet pattern from data driven methods and CVD

Rodríguez-Monforte et al, BJN (2015), 114, 1341–1359
Typical dietary patterns globally 1961-2007, projected to 2050.

16 dietary patterns. Clusters from self-organising map (neural network) using FAO data.

Colours represent 16 different patterns by calorie intake.

Shift from low to high calorie patterns.

Food consumption patterns are changing globally - quantity and composition.

➢ changes will increase global food demand, causing environmental stresses
Choosing the right dietary assessment tool

Welcome to Nutritools
Supporting dietary assessment through guidance and access to validated interactive dietary assessment tools. Funded by the UK Medical Research Council.

Best Practice Guidelines
Step-by-step guidance helping you select the best dietary assessment tool (DAT) for your research. Based on expert consensus.

Strength and Weaknesses of DATs
Compare different types of DATs to determine which DAT is the most suitable for your research.

Visualisation Plots
Compare the characteristics of the DATs, validation study design and the statistical validation data through our Bubble and Summary plots.

Food Questionnaire Creator
Create and develop new food questionnaires or use existing validated questionnaire that have been transformed from paper to web-based on the Food Questionnaire Creator (FQC). Map questions to the latest food databases for easier data collection and nutrient analysis.

Tool E-Library
View and access validated DATs through the Tool E-Library, which provides detailed information on the tool characteristics, validation study protocol, validation results and the special considerations of the tool.

Useful Links
How to measure diet reliably?

myfood24
– a new tool to help researchers (UK, German, Danish versions. Other languages and databases possible.

https://www.myfood24.org/web/
Novel methods and ‘big’ data of relevance to food patterns?

- App data, on-line diet recording, metabolomics
- Food purchase, labels, loyalty card
  - Restaurant/fast food location
- Twitter, social media
  - Town planning data
- Travel – road maps
  - Census, national surveys
- Healthcare data – 1º care & 2º care
  - Sensors (fitbits etc)
Key points – dietary patterns and health:

- understand how food/nutrient intakes link with disease outcomes
- different approaches to creating patterns:
  - hypothesis oriented or exploratory
- Use of patterns in trials is challenging
- Need better measures of diet
- New approaches with new opportunities

Thank you!