Supplementary Table S1. Existing challenges in the field of dietary assessment

Inherent measurement errors in self-report dietary assessment instruments (Gibson 2005):

- Random errors:
  - Mostly attributable to intra-individual (day-to-day) variation in intakes
- Systematic errors:
  - Biases originating from a variety of possible sources during data collection, including:
    - The respondent (e.g. social desirability, difficulty estimating portion size)
    - The interviewer (e.g. non-standardised questions)
    - The tool (e.g. FFQ with 2 vs. 10 questions on fruits and vegetables)

Challenges related to food and nutrient databases:

- Incomplete lists of foods or nutrients. Reasons may include:
  - Lack of data on branded products
  - Values missing for specific nutrients in a high proportion of the database (e.g. *trans* fatty acids)
- Dynamic/rapidly changing food supply, resulting in the need for frequent updates

Challenges related to differences in food supply, food fortification practices or food habits between countries:

- Assumptions that are often made about the similarity of those characteristics between different countries encourage (erroneously) the use of tools and databases from one country without prior adaptation or testing in an other

Limited availability and use of objective measures of intakes (biomarkers):

- Limited number of existing recovery or predictive biomarkers:
  - Recovery biomarkers (Freedman et al. 2015; Jenab et al. 2009):
    - Doubly labeled water (energy intakes)
    - 24-hour urinary nitrogen (protein intakes)
    - 24-hour urinary potassium (potassium intakes)
    - 24-hour urinary sodium (sodium intakes)
  - Predictive biomarkers (Tasevska et al. 2005):
    - 24-hour urinary sucrose and fructose (sugar intakes)
- High cost and participant burden
- Inability to capture eating patterns, overall diet quality or contextual information (e.g. when, where and why individuals make specific food selection decisions)

References:

Freedman, L.S., Commins, J.M., Moler, J.E., Willett, W., Tinker, L.F., Subar, A.F., et al. 2015. Pooled results from 5 validation studies of dietary self-report instruments using recovery biomarkers for potassium and sodium intake. Am. J. Epidemiol. **181**(7): 473-487. doi:10.1093/aje/kwu325. PMID:25787264.

Gibson, R.S. 2005. Principles of Nutritional Assessment. Second Edition. Oxford (UK). Oxford University Press.

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Tasevska, N., Runswick, S.A., McTaggart, A., and Bingham, S.A. 2005. Urinary sucrose and fructose as biomarkers for sugar consumption. Cancer Epidemiol. Biomarkers Prev. **14**(5): 1287-1294. doi:10.1158/1055-9965.EPI-04-0827. PMID:15894688.

Supplementary Table S2. Major characteristics and sources of measurement errors of the most common self-report dietary assessment methods

	24-hour recalls (24HR)	Food records (FR) / diaries	Food frequency questionnaires (FFQ)	Brief and focused instruments (Screeners)
Characteristics:				
Type of dietary intakes primarily captured	Short-term*	Short-term*	Long-term / Usual	Long-term / Usual
Diversity and number of dietary factors	(+)	(+)	(+/-) (depending on level of detail)	(-)
Costs	(+) (unless technology-based)†	(+) (unless technology-based)	(+) (unless technology-based)	(-)
Comparability across studies/contexts	(+)	(+)	(-)	(-)
Feasibility in large scale/epidemiological studies	(+) (particularly if technology-based)	(-) (unless technology-based)	(+) (particularly if technology-based)	(+)
Sources of error:				
Random error	(+)	(+)	(-)	(-)
Systematic error (bias) (non-exhaustive list):				
Respondent burden	(-)	(+)	(+/-) (depending on level of detail)	(-)
Reactivity	(-)	(+)	(-)	(-)
Reliance on memory	(+) (short-term)	(-)	(+) (long-term)	(+) (long-term)
Coding errors	(+) (paper- and interviewer-based) (-) (if technology-based, due to automated coding)	(+) (unless technology-based)	(+) (paper- and interviewer-based) (-) (if technology-based, due to automated coding)	(-)

Note: (+) corresponds to more/higher (e.g. more error), (-) corresponds to less/lower (e.g. less error), and (+/-) indicates that the given characteristic or type of error varies depending on some other characteristics of the tool (e.g. more or less error attributable to respondent burden, depending on the level of detail of the FFQ). These are attempts to broadly summarize a complicated body of research; readers are encouraged to consult other sources for more detail. For example, additional information on each of the most common self-report dietary assessment methods and further comparison of the methods can be found on the Dietary Assessment Primer Website (National Institutes of Health, National Cancer Institute): https://dietassessmentprimer.cancer.gov/profiles/ (Accessed: 13 May, 2016).

*24HR and FR can also be used to estimate usual intake with repeat administrations and statistical modelling.

†The costs associated with the development of technology-based assessment tools (such as web interface) can be quite important and need to be factored in. However, once available, such tools become extremely cost-efficient.

Supplementary Table S3. Strategies to foster high-quality dietary data collection and analysis in nutrition-related research

- **Develop and use analytic methods to address issues associated with random error and mitigate systematic error. Current recommendations include (Subar et al. 2015):**
  - Designing calibration sub-studies as part of larger studies to allow adjustment for measurement error. This includes:
    - Measuring one or more of the currently available recovery and predictive biomarkers in a subset of the study sample
    - Using 24HRs or FRs in a subset of the study sample when an FFQ is the primary dietary assessment tool used in a study
  - Stratifying the study population according to characteristics known to have an impact on reported intakes. For example:
    - Energy-reporting status (under-, normal-, over-reporters)
    - Body mass index
    - Education level
  - Combining data from short-term and long-term self-report instruments to improve precision (Carroll et al. 2012)
  - Refraining from using self-reported energy intake as a measure of energy intake
  - Using self-reported energy intake for energy adjustment of other self-reported dietary constituents
- **Identify and implement interventions that will support the choice of the least-biased tool (or combination of tools) for a given study design and purpose. For example:**
  - Provide training opportunities for trainees, investigators, and knowledge users on dietary assessment methods, so that they develop skills in the collection, analysis and dissemination of dietary data
  - Create repositories of available tools specific to and tested in a given population
- **Improve dietary assessment methods:**
  - Identify additional recovery and predictive biomarkers of intakes as well as ways to combine the information they provide with self-report data
  - Develop and test new tools that use technology:
    - Computer-/web-based methods have the potential to facilitate data collection, reduce data entry/coding errors and reduce costs in large scale studies
- **Adapt and test tools and databases originating from other countries prior to their use in a given country**
- **Develop guidelines or checklists for the accurate dissemination or review of dietary assessment data in scientific papers**
- **Improve the accuracy of food and nutrient composition databases:**
  - Inclusion of brand data
  - Increase the frequency of updates

References:

Carroll, R.J., Midthune, D., Subar, A.F., Shumakovich, M., Freedman, L.S., Thompson, F.E., and Kipnis, V. 2012. Taking advantage of the strengths of 2 different dietary assessment instruments to improve intake estimates for nutritional epidemiology. Am. J. Epidemiol. **175**(4): 340-347. doi:10.1093/aje/kwr317. PMID:22273536;

Subar, A.F., Freedman, L.S., Tooze, J.A., Kirkpatrick, S.I., Boushey, C., Neuhouser, M.L., et al. 2015. Addressing Current Criticism Regarding the Value of Self-Report Dietary Data. J. Nutr. **145**(12): 2639-2645. doi:10.3945/jn.115.219634. PMID:26468491.