

# measurement ERROR webinar series

## Assessing diet-health relationships with FFQ: focus on dietary components consumed daily by nearly all persons

(Webinar 7)

### Objectives:

- Identify challenges in estimating diet-health relationships caused by measurement error in dietary assessment, with a focus on components consumed nearly daily by nearly all persons.
- Describe approaches to correct estimated diet-health relationships for bias due to measurement error when diet is assessed by a food frequency questionnaire.
- Understand the role of calibration studies in assessing and correcting for measurement error in dietary instruments.

### Recommended resources:

- Carroll RJ, Ruppert D, Stefanski LA, Crainiceanu CM. Measurement error in nonlinear models: a modern perspective, 2<sup>nd</sup> edition. Boca Raton, FL: Chapman and Hall CRC Press; 2006. Chapter 4, Regression calibration.
- Freedman LS, Schatzkin A, Midthune D, Kipnis V. Dealing with dietary measurement error in nutritional cohort studies. *J Natl Cancer Inst.* 2011;103:1086-1092.
- Kipnis V, Subar AF, Midthune D, Freedman LS, Ballard-Barbash R, Troiano RP, Bingham S, Schoeller DA, Schatzkin A, Carroll RJ. Structure of dietary measurement error: results of the OPEN biomarker study. *Am J Epidemiol.* 2003;158(1):14-21; discussion 22-6.
- Rosner B, Spiegelman D, Willett WC. Correction of logistic regression relative risk estimates and confidence intervals for measurement error: the case of multiple covariates measured with error. *Am J Epidemiol.* 1990;132(4):734-45.
- Rosner B, Willett WC, Spiegelman D. Correction of logistic regression relative risk estimates and confidence intervals for systematic within-person measurement error. *Stat Med.* 1989;8(9):1051-69; discussion 1071-3.

### Key terms:

**Attenuation factor**

The multiplicative factor by which an estimate of a regression coefficient is shrunk due to measurement error in a covariate.

**Calibration equation**

An equation for predicting a true covariate value (for example, usual dietary intake) given all of the observed covariates in a regression model; usually developed from data gathered in a calibration substudy.

<b>Calibration substudy</b>	A small-scale study performed to enable calibration of the main study instrument using a reference instrument; data from the substudy are used as the basis for regression calibration. Such studies can be conducted either as external calibration or internal calibration.
<b>Confidence interval</b>	A range in which, for a specified degree of assurance, the true value of the parameter lies.
<b>Contamination factor</b>	A value that indicates the magnitude of residual confounding in a regression model with multiple exposures measured with error.
<b>De-attenuation</b>	The process of statistically adjusting the estimated relationship between an outcome and a covariate measured with error to remove bias toward the null.
<b>Exposure</b>	A potential determinant of a health or disease outcome; often a substance in the environment (for example, air pollution) or a personal habit (for example, dietary intake, smoking).
<b>Food frequency questionnaire (FFQ)</b>	A dietary instrument that asks respondents to report their usual frequency of consumption of each food in a list of foods over a specific period of time.
<b>Linear regression</b>	A statistical model that relates a dependent variable (for example, an outcome) to one or more independent variables (for example, exposures).
<b>Logistic regression</b>	Statistical model that relates a binary outcome to one or more independent variables, using the logit link.
<b>Nonepisodically consumed dietary components</b>	A term describing nutrients and foods that are consumed nearly every day by nearly everyone in the population and whose intake may therefore rarely, if ever, be reported as zero on a particular day.
<b>Null hypothesis</b>	An assertion that two or more groups do not differ in the measure of interest or that exposure is not associated with the health outcome under study.
<b>Odds ratio</b>	A statistical measure that quantifies the association between an exposure and a health outcome; often used in case-control studies.
<b>Power</b>	The probability that a test correctly rejects the null hypothesis when the alternative hypothesis is true.

<b>Reference dietary instrument</b>	An instrument that is administered in a substudy and is used to calibrate or validate the main or study instrument; examples include recovery biomarkers. The reference instrument is assumed to provide estimates that are closer to truth than the main instrument.
<b>Regression calibration</b>	A statistical method for correcting estimated regression coefficients for bias due to measurement error in one or more continuous covariates.
<b>Standard error</b>	The standard deviation of the sampling distribution of an estimated population parameter; used to assess the precision of an estimate.
<b>Twenty-four-hour dietary recall (24HR)</b>	A dietary instrument that requires the respondent to remember and report all foods and beverages consumed in the preceding 24 hours or during the preceding day.