

measurement ERROR webinar series

Combining self-report dietary intake data and biomarker data to reduce the effects of measurement error

(Webinar 11)

Objectives:

- To describe the motivation for combining dietary self-reports and biomarkers.
- To provide an overview of different methods of combining self-reports and biomarkers, their aims, and the knowledge required for implementing each method.
- To identify the potential gains of such combinations and the limitations of the methods

Recommended resources:

- Freedman LS, Kipnis V, Schatzkin A, Tasevska N, Potischman N. Can we use biomarkers in combination with self-reports to strengthen the analysis of nutritional epidemiologic studies? *Epidemiol Perspect Innov.* 2010;7(1):2.
- Freedman LS, Midthune D, Carroll RJ, Tasevska N, Schatzkin A, Mares J, Tinker L, Potischman N, Kipnis V. Using regression calibration equations that combine self-reported intake and biomarker measures to obtain unbiased estimates and more powerful tests of dietary associations. *Am J Epidemiol.* 2011 Nov 1. [Epub ahead of print]
- Freedman LS, Tasevska N, Kipnis V, Schatzkin A, Mares J, Tinker L, Potischman N. Gains in statistical power from using a dietary biomarker in combination with self-reported intake to strengthen the analysis of a diet-disease association: an example from CAREDS. *Am J Epidemiol.* 2010;172(7):836-42.

Key terms:

Attenuation	Bias of the estimated regression coefficient in the direction of zero due to measurement error in a covariate; bias to the null.
Attenuation factor	The multiplicative factor by which an estimate of a regression coefficient is shrunk due to measurement error in a covariate.
Biomarker	For the purposes of the webinar series, a biological (usually biochemical) indicator or measure of dietary intake or nutritional status.
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.

Calibration substudy	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.
Carotenoids in Age-Related Eye Disease Study (CAREDS)	Ancillary study of the Women’s Health Initiative (WHI) Observational Study. WHI was a prospective study of 93,676 postmenopausal women aged 50-70 years at time of enrollment (1994-1998).
Case-control study	A type of study that classifies individuals with regard to current disease status (as cases or controls) and relates this to past (retrospectively reported) exposures.
Causal/Causation	A type of relationship between two variables in which a change in the value of one causes the value of the other to change.
Classical measurement error	A type of measurement error consisting of random within-person error, which has a mean of zero and constant variance and which is independent of the true value.
Concentration biomarker	A marker of the concentration of a specific chemical or compound in blood, urine, or tissues that is subject to substantial interindividual differences in metabolism; related to and can be used as an indirect measure of dietary intake.
Confounding	Distortion of an association between an exposure and a health outcome by a third variable that is related to both.
Explanatory variable	A variable thought to be related to an outcome in a regression model.
Food frequency questionnaire (FFQ)	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.
Logistic regression	Statistical model that relates a binary outcome to one or more independent variables, using the logit link.
Measurement error	The difference between the observed or measured value and the true value.

Mediation	A phenomenon by which the causal effect of an exposure on an outcome is partially or wholly obtained through its influence on a third variable (the intermediate variable), which in turn affects the outcome. The intermediate variable is said to mediate the effect of the exposure on the outcome.
Odds ratio	A statistical measure that quantifies the association between an exposure and a health outcome; often used in case-control studies.
Outcome	The target variable; also referred to as the dependent variable in a regression model; often a health outcome, such as the occurrence of a specified disease.
Power	The probability that a test correctly rejects the null hypothesis when the alternative hypothesis is true.
Recovery biomarker	Specific biologic products that are directly related to intake and not subject to homeostasis or substantial interindividual differences in metabolism; for example, doubly labeled water for energy intake and urinary nitrogen for protein intake.
Regression calibration	A statistical method for correcting estimated regression coefficients for bias due to measurement error in one or more continuous covariates.
Regression model	A model used to quantify a relationship between an outcome and one or more explanatory variables; such models are used to estimate usual intake and relate it to other variables of interest.
Standard deviation	A statistical measure of the level of dispersion of a set of values around their mean; square root of the variance.
True intake	Actual intake, which cannot be observed in practice among free-living individuals.
Usual intake	Long-term average daily intake, taking into account both consumption and nonconsumption days.