measurement ERROR webinar series

Glossary of Key Terms and Notation

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z Notation

A

Alternative hypothesis: The hypothesis that is compared to the null hypothesis; in epidemiology, the alternative hypothesis typically states that an exposure is associated with the health outcome under study. In contrast to: Null hypothesis. Related terms: Epidemiology, Exposure, and Outcome.

Association: A relationship between two variables that is not necessarily causal. Related terms: Causal/Causation and Correlation.

Attenuation: Bias of the estimated regression coefficient in the direction of zero due to measurement error in a covariate; bias to the null. Related terms: Attenuation factor and Bias.

Attenuation factor: The multiplicative factor by which an estimate of a regression coefficient is shrunk due to measurement error in a covariate. Related terms: Attenuation and Covariate.

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Back-transformation: A mathematical technique used to restore a variable to its original scale after a transformation has been applied. In contrast to: Transformation. Related term: Box-Cox transformation.

Between-person variance: A measure of the spread of values among persons. In contrast to: Within-person variance. A type of Variance.

Bias: Systematic deviation of observations or estimates from the truth. Related term: Systematic error.

Biomarker: For the purposes of the webinar series, a biological (usually biochemical) indicator or measure of dietary intake or nutritional status. Related terms: Concentration biomarker and Recovery biomarker.

Bivariate: Having to do with two variables. In contrast to: Univariate. Related term: Multivariate.

Box-Cox transformation: A type of power transformation; often applied to skewed data to lessen skewness or to approximate normality. A type of: Transformation. Related term: Back-transformation.

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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. Related term: 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. Related terms: Calibration equation, Main dietary instrument, and Reference dietary instrument.

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. In contrast to Cohort study, Cross-sectional study, and Ecological study. A type of: Observational study.

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. Related term: Association.

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. A type of: Measurement error. Related term: Random error.

Cluster sampling: A type of sampling in which the population of interest is divided into groups or clusters and a random sample of clusters is selected. Related terms: Complex survey sample and Stratified sample.

Cohort study: A study in which exposures of interest are assessed at baseline in a group (cohort) of people and health outcomes occurring over time (observed prospectively) are then related to baseline exposures. In contrast to: Case-control study, Cross-sectional study, and Ecological study. A type of: Observational study.

Complex survey sample: A sample of the population of interest that is drawn using stratification and/or clustering techniques; probability of inclusion in the sample varies among individuals in the population and each member of the population has a known probability of selection. In contrast to: Simple random sample. Related terms: Cluster sampling, Sample survey, and Stratified sample.

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. A type of: Biomarker. In contrast to: Recovery biomarker.

Confidence interval: A range in which, for a specified degree of assurance, the true value of the parameter lies.

Confounding: Distortion of an association between an exposure and a health outcome by a third variable that is related to both. Related term: Residual confounding.

Constant additive error: A component of systematic error that consists of a constant value that is added to the true value for each person. A type of: Systematic error.

Consumption day: A day on which a particular nutrient or food is consumed by a specific individual.

Contamination factor: A value that indicates the magnitude of residual confounding in a regression model with multiple exposures measured with error. Related terms: Confounding and Residual confounding.

Correlation: A measure of linear association between two variables. Related term: Association.

Covariance: A measure of how much two variables change in concert with each other.

Covariate: A variable that is related to the outcome or dependent variable in a regression model; may be referred to as an exposure. In contrast to: Dependent variable and Outcome. Related terms: Explanatory variable, Exposure, and Independent variable.

Cox regression: A statistical method for relating the time until a specified event (for example, a health outcome or mortality) to covariates of interest; also known as the proportional hazards model. Related terms: Covariate and Hazard ratio.

Cross-sectional study: A study that includes measurements on a group of individuals at a single interval in time. In contrast to: Case-control study, Cohort study, and Ecological study.

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Day-of-week effect: A phenomenon indicating how overall mean intake varies according to the day of the week. A type of: Nuisance effect. Related terms: Mode effect and Sequence effect.

De-attenuation: The process of statistically adjusting the estimated relationship between an outcome and a covariate measured with error to remove bias toward the null. In contrast to: Attenuation. Related terms: Attenuation factor and Outcome.

Density model: Regression model used for examining diet-health relationships in which nutrients or foods are expressed as densities (that is, ratios of nutrients or foods to energy).

Dependent variable: The target variable; also referred to as the outcome in a regression model; in epidemiology, this is often a health outcome such as the occurrence of a specified disease. In contrast to: Independent variable. Related term: Outcome.

Dietary intake: Intake from foods and beverages (excludes supplements). Related term: Total nutrient intake.

Dietary patterns: For the purpose of this webinar series, this term refers to the combination of foods and beverages that constitute an individual's dietary intake over time.

Dietary Reference Intakes (DRI): A set of intake recommendations from the Institute of Medicine (IOM) of the National Academies for nutrients and other dietary components. DRIs include Estimated Average Requirement and Tolerable Upper Intake Level.

Dietary supplement: Vitamins, minerals, herbs or other botanicals, amino acids, and other substances taken orally, which are intended to supplement the diet. Related term: Total nutrient intake.

Distribution: The pattern of values taken on by a random variable. Related terms: Mean, Median, Normal distribution, Percentile, Probability distribution, Quantiles, Random variable, and Skewed distribution.

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Eating at America's Table Study (EATS): A study conducted by the National Cancer Institute in 1997-1999 to validate the Diet History Questionnaire, a food frequency questionnaire, and two dietary screeners; included a nationally representative sample of 1,640 men and women aged 20-70 years.

Ecological study: A study in which the units of analysis are groups of individuals (often the populations resident in different countries, states, or other areas) rather than single individuals. In contrast to: Case-control study, Cohort study, and Cross-sectional study.

Energy adjustment: Adjustment of nutrient intake for total energy intake. Related terms: Nutrient density and Residual.

Energy density: Energy (kilocalories) per weight (gram) of food.

Epidemiology: The study of the distribution and determinants of health outcomes or diseases among populations and the application of that study to enhancing public health.

Episodically consumed dietary components: Nutrients and foods that are not consumed on a daily basis by nearly everyone in the population and whose intake may therefore commonly be reported as zero on a particular day. In contrast to: Nonepisodically consumed dietary components.

Error-prone variable: A variable typically measured with error.

Estimated Average Requirement (EAR): The average daily nutrient intake level estimated to meet the requirements of half of the healthy individuals in a particular age and sex group. The EAR can be used to estimate the prevalence of the population of interest with inadequate intakes of a particular nutrient. Type of: Dietary Reference Intakes. Related term: Tolerable Upper Intake Level.

Explanatory variable: A variable thought to be related to an outcome in a regression model. In contrast to: Dependent variable and Outcome. Related terms: Covariate, Exposure, and Independent variable.

Exposure: 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). In contrast to: Dependent variable and Outcome. Related terms: Covariate, Explanatory variable, and Independent variable.

External calibration: Calibration performed using data from an external study (that is, a study that is conducted with participants who are not in the main study). In contrast to: Internal calibration. Related term: Calibration substudy.

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Feeding study: A study in which all foods and drinks available to the participants during the study period are measured and controlled by the investigators, and the amounts consumed are recorded by observers, as in a clinical trial.

Flat slope: A syndrome affecting dietary data due to overreporting among those with the lowest levels of intake and underreporting among those with the highest levels of intake. When reported dietary intakes are regressed on true intakes, the result is a regression slope less than one. Related term: Intake-related bias.

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. Related term: Long-term instrument.

Food record: A dietary instrument in which a respondent is asked to record all foods and beverages and amounts of each consumed over one or more days. Related term: Short-term instrument.

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Hazard ratio: A ratio similar to relative risk; it expresses the relative effect of a variable on the risk of an event (such as the development of a disease) in the context of a Cox regression model. Related terms: Cox regression and Relative risk.

Healthy Eating Index: A measure of dietary quality that assesses compliance with the Dietary Guidelines for Americans.

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Independent variable: A variable thought to be related to an outcome in a regression model; also called Explanatory variable. In contrast to: Outcome. Related terms: Covariate and Exposure.

Individual-level time-independent covariate: A variable that remains fixed for a given individual during a longitudinal study, such as sex, baseline age, and race/ethnicity. In contrast to: Time-dependent covariate. Related term: Covariate.

Intake-related bias: Systematic deviation from the truth arising from correlation between error and true intake; for example, persons with low energy intake may overreport intake and persons with high energy intake may underreport intake. Type of: Systematic error. Related term: Flat slope.

Internal calibration: Calibration performed using data from a substudy conducted in a randomly selected subgroup of participants of the main study. In contrast to: External calibration. Related term: Calibration substudy.

Iowa State University (ISU) method: A statistical modeling approach used to estimate distributions of usual intake. Other methods include the MSM method, the NCI method and the NRC method.

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Latent variable: A variable that is not directly observed but is inferred.

Linear regression: A statistical model that relates a dependent variable (for example, an outcome) to one or more independent variables (for example, exposures). A type of: Regression model. Related terms: Covariate, Dependent variable, Exposure, Independent variable, and Outcome.

Link function: A mathematical transformation of the mean outcome that is used to relate the mean outcome to a set of predictors in a regression model. Related terms: Logistic regression, Probit regression, and Regression model.

Logistic regression: Statistical model that relates a binary outcome to one or more independent variables, using the logit link. Related terms: Link function and Regression model.

Long-term instrument: A dietary instrument that captures intake over a long period of time, such as a Food frequency questionnaire. In contrast to: Short-term instrument.

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Main dietary instrument: The primary dietary instrument used in a study, sometimes referred to as the study instrument; may be calibrated or validated using a reference instrument. In contrast to: Reference instrument. Related terms: Calibration substudy and Validation study.

Markov chain Monte Carlo method: A technique used to estimate the parameters of statistical models through simulation. Related term: Monte Carlo simulation.

Maximum likelihood estimation: A technique used to estimate the parameters of statistical models, based on the principle that the best estimates of the parameters are those for which the observed data could most likely have arisen.

Mean: An indicator of central tendency, derived as the average of a set of values (the sum of the values divided by the number of values in the set). Related term: Median.

Measurement error: The difference between the observed or measured value and the true value. Related terms: Random error and Systematic error.

Median: An indicator of central tendency, derived as the middle value in a set of ordered numbers. Related term: Mean.

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. Related terms: Exposure and Outcome.

Mode effect: Refers to differences in observed intakes due to the method of administration of an instrument (for example, mail, telephone, Web-based, in-person, interviewer-administered, self-administered). A type of: Nuisance effect. Related terms: Day-of-week effect and Sequence effect.

Monte Carlo simulation: A method for obtaining estimates through simulation rather than direct calculation; often used to estimate percentiles and other characteristics of the usual intake distribution. Related term: Markov chain Monte Carlo method.

Multiple Source Method (MSM): A statistical modeling approach used to estimate distributions of usual intake. Other methods include the ISU method, the NCI method, and the NRC method.

Multivariate: Having to do with two or more variables. In contrast to: Univariate. Related to: Bivariate.

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National Cancer Institute (NCI) method: A unified approach for estimating usual intake distributions and predicting individual intakes for use in diet and health models; can be used for dietary components consumed nearly daily by nearly all persons and those consumed episodically. Other methods of estimating usual intake distributions include the ISU method, the MSM method, and the NRC method. Related terms: One-part model and Two-part model.

National Health and Nutrition Examination Survey (NHANES): A representative survey of the civilian, noninstitutionalized U.S. population conducted by the National Center for Health Statistics; used to monitor diet and study associations between diet, nutrition, and health. Related term: What We Eat in America.

National Institutes of Health-American Association of Retired Persons Diet and Health Study (NIH-AARP): A diet and health cohort study of more than 500,000 Americans aged 50-71 years in 1995-1996.

National Research Council (NRC) method: An early statistical modeling approach to estimate usual intake distributions; extended by researchers at Iowa State University. Other methods include the ISU method, the MSM method, and the NCI method.

Never consumers: Individuals who never consume a particular food or nutrient.

Nonepisodically consumed dietary components: 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. In contrast to: Episodically consumed dietary components.

Normal (Gaussian) distribution: A probability distribution that is symmetrical (i.e., density function resembles a bell-shaped curve); occurs commonly in nature, such as heights of adults in a homogeneous population. In contrast to: Skewed distribution.

Nuisance effect: A variable that has an effect on observations but is of no intrinsic interest itself. Examples include interview sequence and mode of administration of the instrument. Related terms: Mode effect and Sequence effect.

Null hypothesis: 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. Related term: Alternative hypothesis.

Nutrient density: Ratio of nutrient intake to total energy intake, often expressed either as a percentage of total energy or amount per 1,000 kilocalories.

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Observational study: A study in which the investigator observes rather than influences exposures and outcomes; includes: Case-control study and Cohort study. Related terms: Exposure and Outcome.

Observing Protein and Energy Nutrition (OPEN): A study conducted by the National Cancer Institute in 1999-2000 to assess dietary measurement error using two self-report instruments (24HR and FFQ) and unbiased biomarkers of energy and protein intakes; included 484 men and women aged 40-69 years living in Montgomery County, Maryland.

Odds ratio: A statistical measure that quantifies the association between an exposure and a health outcome; often used in case-control studies. Related terms: Logistic regression and Case-control study.

One-part model: For the purposes of this webinar series, this term refers to a model developed by the National Cancer Institute for estimating usual intake distributions of nonepisodically consumed dietary components and predicting individual intakes of nonepisodically consumed dietary components for use

in diet-health models. In contrast to: Two-part model. Related terms: NCI method and Nonepisodically consumed dietary components.

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. In contrast to: Exposure and Independent variable. Related term: Dependent variable.

Outlier: A value substantively or statistically different from all (or nearly all) of the other values in a distribution.

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Percentile: The value below which the specified percent of observations fall. Related term: Distribution.

Person-specific bias: The difference between an individual's reported intake averaged over many repeated measures and true usual intake, after taking constant additive error and intake-related bias into account. It is constant within an individual but randomly changes between individuals, with a mean of zero and constant variance. A type of: Systematic error.

Person-specific random effect: The difference between the within-person average value and the value predicted by covariates such as age and sex; both parts of the two-part National Cancer Institute method model include a person-specific random effect. Related terms: NCI method and Two-part model.

Poststratification: A statistical adjustment procedure by which survey sampling weights are adjusted to reproduce known totals for subpopulations. Related terms: Complex survey sample and Stratified sample.

Power: The probability that a test correctly rejects the null hypothesis when the alternative hypothesis is true. Related terms: Alternative hypothesis and Null hypothesis.

Probability: The chance of a particular event or value; how likely an event is to occur. Related term: Probability distribution.

Probability distribution: The pattern of values showing the relative frequencies associated with all possible values of a random variable in a population. Examples include Normal, t, F, Binomial, and Chi-square. Related terms: Normal distribution, Probability, and Random variable.

Probit regression: A statistical model for predicting the probability of a binary outcome using the probit link function. Also see Logistic regression and Link function.

Prospective study: A study in which participants are recruited and their exposures measured before the health outcome of interest has occurred. In contrast to: Retrospective study. Related terms: Exposure and Outcome.

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Quantiles: Values that divide data or a distribution into equal-size groups; for example, quartiles are quantiles that divide the data into four equally sized groups.

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Random error: A source of error that contributes variability (reduces precision) but does not influence the sample mean or median; a type of: Measurement error. In contrast to: Systematic error.

Random variable: A characteristic of interest that takes on values not directly fixed by an experiment. Examples include dietary intake, height, and weight.

Random within-person error: Variation in the observed value of a variable when it is repeatedly measured in the same individual; for example, day-to-day variation in dietary intake reported using multiple 24-hour recalls.

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. A type of: Biomarker. In contrast to: Concentration biomarker.

Reference dietary instrument: 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. In contrast to: Main dietary instrument. Related terms: Calibration substudy, Recovery biomarker, and Validation study.

Reference period: The time period to which a dietary assessment instrument pertains, such as 24 hours for a 24-hour recall, some number of days for a food record, or the period the participant is asked to recall (usually 30 days to 1 year) for a food frequency questionnaire. Related terms: Long-term instrument and Short-term instrument.

Regression calibration: A statistical method for correcting estimated regression coefficients for bias due to measurement error in one or more continuous covariates. Related terms: Bias, Calibration substudy, Covariate, and Relative risk.

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. Related terms: Cox regression, Linear regression, Logistic regression, and Probit regression.

Relative risk: A statistical measure that quantifies the association between an exposure and a health outcome; often used in cohort studies. Related terms: Cohort study, Exposure, Hazard ratio, and Outcome.

Replicates/repeats: A repeated measure; for example, a second 24-hour recall or a second doubly labeled water measurement.

Resampling methods: Techniques used to approximate the variance of population parameter estimates. Methods include balanced repeated replication (BRR), bootstrap, and jackknife. An alternative to resampling methods is Taylor linearization.

Residual: The difference between a data point and the value predicted for it by a model.

Residual confounding: A phenomenon that occurs when a confounding variable is measured with error and another related covariate in the regression model adopts a fraction of its effect. Related terms: Confounding and Contamination factor.

Retrospective study: A study in which participants are recruited after the health outcome of interest has been determined. In contrast to: Prospective study. Related term: Outcome.

R-squared: A statistical measure of how much variation in the outcome is explained by the variable or set of variables in a linear regression model. Related terms: Linear regression and Regression model.

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Sample survey: A survey of a sample of individuals rather than the entire population of interest; every member of the population has a known probability of being selected into the sample. Related terms: Complex survey sample and Simple random sample.

Self-reported intake: Intake as reported by the individual who actually consumed the dietary component; can be measured using various dietary instruments. Related term: True intake.

Sensitivity: A statistical measure that quantifies how well a test identifies true cases. Related term: Specificity.

Sequence effect: The effect of repeated administration of an instrument on reported intakes. Related terms: Day-of-week effect, Mode effect, and Nuisance effect.

Short-term instrument: A dietary instrument that captures intake over a short period of time, such as a Food record or 24-hour recall. In contrast to: Long-term instrument.

Simple random sample: A sample in which each person in the population of interest has the same probability of being selected. In contrast to: Complex survey sample. Related term: Sample survey.

Simulation study: A method used to validate statistical procedures that involves generating random samples from a hypothetical distribution and computing statistical estimates for each sample.

Skewed distribution: A distribution that is not symmetrical. In contrast to: Normal distribution.

Specificity: A statistical measure to quantify how well a test correctly identifies persons who do not have the outcome of interest. Related term: Sensitivity.

Standard deviation: A statistical measure of the level of dispersion of a set of values around their mean; square root of the variance. Related term: Standard error.

Standard error: The standard deviation of the sampling distribution of an estimated population parameter; used to assess the precision of an estimate. Related term: Standard deviation.

Stratified sample: A sample in which subsets of sampling units are selected separately from different subgroups of the population rather than from the population as a whole. Related terms: Cluster sampling and Complex survey sample.

Surveillance: A general term for monitoring; in the context of nutrition, refers to tracking the population's diet- and nutrition-related health events.

Survey design methods: Statistical techniques related to the design features of complex surveys, including clustering, stratification, and weighting. Related terms: Cluster sampling, Complex survey sample, and Stratified sample.

Systematic error (bias): A source of error in which measurements consistently depart from the true value in the same direction; affects the sample mean or median and can result in incorrect estimates and conclusions. Related terms: Constant additive error, Intake-related bias, and Person-specific bias.

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T

Time-dependent covariate: A covariate that changes in value over time. Related terms: Covariate and Individual-level time-independent covariate.

Tolerable Upper Intake Level (UL): The highest average daily nutrient intake level likely to pose no risk of adverse health effects to almost all individuals in the general population; as intake increases above the UL, the potential risk of adverse effects increases. A type of: Dietary Reference Intake. Related term: Estimated Average Requirement.

Total nutrient intake: A term referring to nutrient intake from all sources, including food, beverages, and dietary supplements. In contrast to: Dietary intake. Related term: Dietary supplement.

Transformation: The application of a mathematical function (for example, the logarithm or the square root) to a set of values to create a new set of values. In contrast to: Back-transformation. Related term: Box-Cox transformation.

True intake: Actual intake, which cannot be observed in practice among free-living individuals. Related term: Self-reported intake.

Twenty-four-hour dietary recall (24HR): 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. Related term: Short-term instrument.

Two-part model: For the purposes of the webinar series, a statistical regression model developed by the National Cancer Institute for estimating usual intake of dietary components that are episodically consumed; models the probability of consuming the component on a particular day as well as the usual amount consumed on a consumption day. In contrast to: One-part model. Related terms: NCI Method and Usual amount consumed.

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U

Unbiased instrument: An instrument with only random error. Related term: Random error.

Underreporting: A phenomenon in which an individual reports less than his/her true intake; for energy intake, it can be quantified by comparing reported energy intake with measures derived from doubly labeled water or the Goldberg equation for plausible energy intake.

Univariate: Having to do with one variable. In contrast to: Bivariate and Multivariate.

Usual amount consumed: For episodically consumed dietary components, the usual amount consumed is the long-term average amount consumed on consumption days; when multiplied by the probability of consuming the dietary component, the product equals usual intake. Related terms: Episodically consumed dietary components and Usual intake.

Usual intake: Long-term average daily intake, taking into account both consumption and nonconsumption days.

Usual intake distribution: A distribution that describes usual intakes, including the mean and percentiles, among a population.

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Validation study: A study conducted to evaluate measurement error structure of an instrument by comparing it with a reference instrument. Often used interchangeably with Calibration substudy. Related term: Reference instrument.

Variance: A measure of the spread in a set of observations; it is equal to the mean squared difference between observations and their mean value. Related terms: Between-person variance and Within-person variance.

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W

What We Eat in America (WWEIA): The dietary intake interview component of the National Health and Nutrition Examination Survey (NHANES).

Within-person variance: A measure of the variation in repeated observations of a variable in the same person. In dietary measurement using 24-hour recalls, it is the day-to-day variation in reported dietary intake of an individual. Related terms: Between-person variance and Variance.

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Notation

Concept	Notation
Main study sample size	N
Calibration study sample size	n
Number of repeats of instruments	J
Individual	subscript i
Day or repeat	subscript j
Label for intake variable or covariate (if there is a series of them)	subscript k
Health outcome	Y
True usual intake	T
Reported intakes (either generic reported outcome or 24HRs/food records)	R
Food frequency questionnaire (FFQ)	Q
Biomarker	M
Correlation	ρ
Attenuation-contamination matrix	Λ
Box-Cox function	$g(.;\gamma)$
Box-Cox parameter	γ
Predicted true intake	T^p or $E(T\|X)$
Health outcome model (most general form)	$h(E(Y\|X))=\eta(\alpha,X)$
Covariates in a health outcome model	Z
Additional factors related to usual intake but not the outcome in an enhanced regression calibration model	C
All covariates in a health outcome, measurement error, or regression calibration model	X
Coefficients for X in a measurement error model	β
Coefficients for X in a health outcome model	α
Coefficients for X in a regression calibration model	λ
Generic error in a regression model	e
Within-person error	ε
Person-specific bias (random effect)	u
Estimate	^

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